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PUBLIC WORKS

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CITY COUNTY STATE

PUBLIC WORKS is devoted to the design, construction, maintenance and operation of *public improvements.*

The major subjects covered are: Highways, Water Supply, Sewerage, Refuse Collection and Disposal, Street Cleaning, Bridges, etc.

Vol. 61 June, 1930 No. 6

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A Golden Jubilee

The 50th annual convention of the American Water Works Association will be held in the first week of June. The association fittingly returns to St. Louis, the place of its first convention in 1881, to celebrate its fifty years of service to the water works profession. All indications are that this meeting will be perhaps the most successful that has yet been held.

The strict limits of space in this column prevent us from reviewing, even in a brief fashion, the tremendous and beneficial influence that the American Water Works Association has wielded since its formation. Its history parallels the history of water works progress, for which it has been so largely responsible.

And yet, it has before it an opportunity for still greater work. The first step, perhaps, and one that is in most capable hands, is that of building up the membership. Arthur Gorman has been giving much of his time for the past three months to a campaign to add 500 members to the rolls before the convention ends. We hope that before our readers leave home they will have tucked into their pockets the little extra sum required for this investment in knowledge and educational polish. It could not be spent to better advantage.

In This Issue:

"Hydraulic Fill Construction at the Cobble Mountain Dam" is told by the man who knows the most about it, and in a way that should be of interest to every waterworks engineer. "Albany's New Water Supply" tells of one of the most interesting long and large main installations of recent years. Kinks in washing filter stone are described in page 33, and Willem Rudolf's article describes German methods of sewage treatment. Prof. Martin's second article is one of the most valuable we have ever published. Other articles we cannot refrain from mentioning are those on contract maintenance by Mr. White; on flood-proofing roads by Mr. Coleman; and our own compilation showing water mains laid in 1929, as reported to us by about 700 engineers in charge of water works.

In the Next Issue:

Because of a flow of material too good to hold over, some of the articles planned for this issue had to be slated for the July issue. In that number will be the concluding installment of "Making the Road Money Go Further;" and a number of other articles on road and street construction which have been contributed by our readers in the field. Data on glass-covered sludge beds, held over from this issue, and a group of other selected articles on sewerage and sewage treatment. "What Correspondence Instruction Offers Engineers" is written by one of the leading educators in that field. More on water works and water purification.

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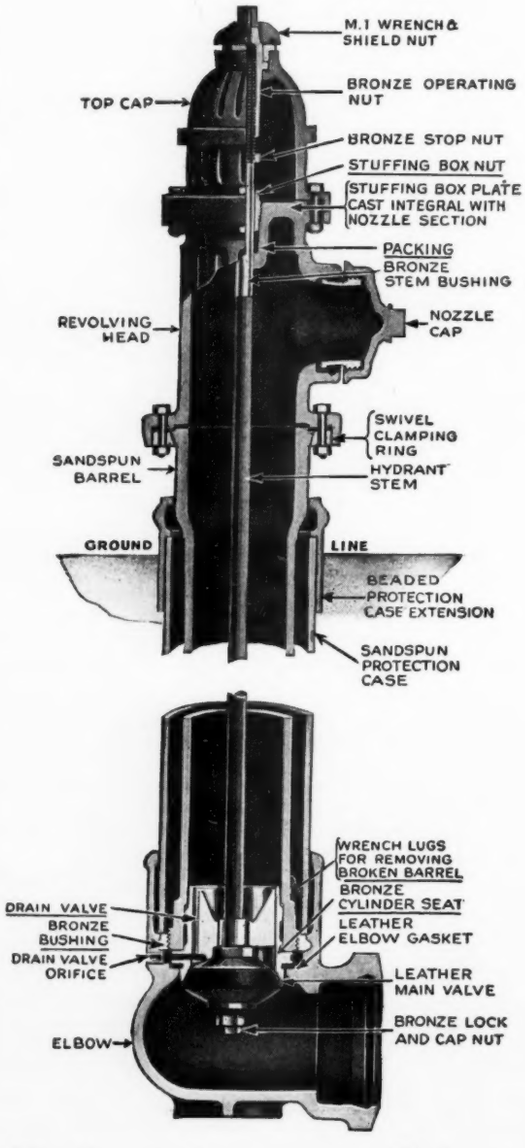

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PUBLIC WORKS
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AN ENGINEERING AND CONSTRUCTION MONTHLY
Vol. 61 June, 1930 No. 6

Hydraulic Fill Construction at Cobble Mountain Dam

By H. H. Hatch, M. Am. Soc. C. E.,
Division Engineer

THE construction of the Cobble Mountain Dam, the plan of which was described in our issue of September, 1928, is of great interest, not only because it is one of the highest earth dams in the world and is being constructed by hydraulic fill, but because of the planning and study given to the details of construction. By means of a completely-equipped physical laboratory, careful control has been maintained of the material going into the dam.

Sluicing the hydraulic fill was begun last fall and carried on for about a month before cold weather necessitated a discontinuance; and was started again shortly after May 1 of this year. The accompanying picture shows the work under way on May 7, 1930.

The following article by Mr. Hatch gives data and details of design and construction. It is the first of a series which will cover the essentials in the design and construction of this dam.

COBBLE MOUNTAIN dam is being built by the city of Springfield, Mass., as part of extensive works undertaken to meet the necessity for increased water supply of that city of 150,000 population. It is being built by the hydraulic-fill method across Little River at a point about five miles above where the supply of the city is now being taken and filtered.

Little River here flows south, turns at right angles and then flows east. The dam is located just east of the bend. To carry the flow of the river around the dam site during construction, a diversion tunnel was carried under a mountain, beginning just north of the bend, and discharging into the river again just east of the dam site; the flow being diverted into the tunnel by means of a rock-fill diversion dam 72 feet high, built at the location of the up-stream toe of the dam and to remain permanently as part of same.

View of Core Pool from Upper Rock Fill or Diversion Dam. Lower Rock Fill in Background. Core Pool Pump House Floating in Pool, from Which, at the Left, Leads the Main Water Line Feeding the Hydraulic Nozzles.

Above—One of the Hydraulic Nozzles, or "Giants," Excavating Material for Hydraulic Fill.

Above—Another Hydraulic Nozzle. At Left — Flow from Nozzles Carrying Soil to Sluices. In Background Head Box of Sluice Ditches, Protected by Grizzly.

The dam will have a maximum height of 245 feet above bed rock, and a water level 215 feet above the stream bed. It will be 1505 feet thick at the base and 50 feet at the crest, and be 700 feet long on the crest. At the down-stream toe is a concrete wall fifty feet high, back of which is laid rock fill for a distance of 460 feet, the face of it sloping from 1 on 5 to 1 on 3¼. In the center of the dam is a core of clay puddle deposited hydraulically, not less than 10.5 feet wide at the top nor more than 35.5 feet, and not less than 152 nor more than 222 feet at the bottom. Between the core and each rock-fill toe is deposited a shoulder of sand, gravel and rock—all the material brought by the sluices that is not used in the core; the down-stream shoulder being underlaid by a thin layer of open rock fill for drainage.

As first planned, the lower rock fill was to extend about 100 feet back from the concrete toe wall; but agitation started by the failure of the St. Francis dam resulted in considerably increasing this rock fill and also adding about 200 feet of rock fill back of the up-stream diversion dam, as measures of additional safety.

Material for the core and shoulders is excavated by hydraulic nozzles and carried by the water to sluice ditches and by them to pipes, which in turn carry it to the dam site. The water used—which may reach or exceed twenty-five million gallons a day—is pumped back and used over and over again; because there would be no place to dispose of it except to let it run down the river to the filter plant, where the silt retained in suspension would hamper filter operation and increase its cost; and also the flow in excess of daily consumption by the city is used by paper mills, and the turbid water would result in law suits against the city.

Either hydraulic fill or semi-hydraulic fill may be used in dam construction. In the case of hydraulic fill dams, all the material within the fill is washed and there is a complete separation of the material along the beaches and in the core. As the material is discharged from the pipe or open sluice, the larger particles drop out first, smaller ones are carried a little distance, and the very finest ones go to the core section. In some cases the material is excavated by water and carried long distances to the dam in pipes by water, when it is obvious that the material will be broken up more thoroughly and there is apt to be a better gradation of material from coarse to fine along the beaches. However, there is no distinction made, in the definition, whether or not the material is excavated and conveyed to the site by water. So long as all the fill material is washed, even though the gradation may not be complete, the method is defined as hydraulic fill.

Semi-hydraulic fills are dry excavated, and, as a rule, the material is hauled and dumped from trestles built within the shoulder of the dam; only a small portion of this material next to the upper and lower limits of the core is sluiced. A big portion of the body of these dams is not affected by water at all.

Originally the contractor for this dam planned to

Diversion Dam, or Upper Rock Fill Toe. A Right, Beach of Core Pool. In Background, Intake Pool, on Which Floats Intake Pump House.

East End of Core Pool. Eastern Beach Pipe in Foreground, Leading from Mud Pipe. At Right of This, Part of Rock Fill Toe. Further to the Right, Concrete Toe Wall. Below This, the Channel of Little River Extends to the East.

use the semi-hydraulic method (for which we required that 90 per cent of the fill be washed), excavating the material in the borrow pits with steam shovels and bringing it over a distance of about one mile to the shoulders of the dam, whence the material would be washed into place by water. This meant the use of at least six shovels, including one for spare and another one for moving from place to place to bring the mixture of the material to the required qualifications; also a standard-gauge track of over three miles and a sufficient number of cars to handle the required maximum of 10,000 yards a day. He, however, finally adopted hydraulic fill, including hydraulic excavation.

The chief factor in the contractor's decision to use the hydraulic method was the labor problem. In hydraulic fill operation, labor is reduced to a minimum; nearly everything is done by machinery and water. The only weather conditions that need interfere with the operation is cold so great as to freeze the ground or make satisfactory separation impossible and cause the beaches to freeze up in layers.

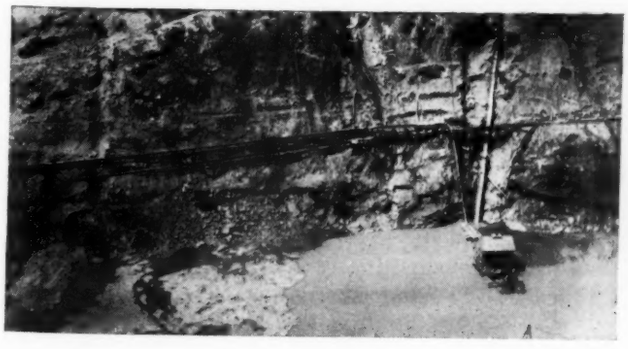
Activities during the fall of 1929 were confined to what we call the Stow Valley pits, located about eight hundred feet southwest of the diversion dam. Here the soil was excavated by hydraulic "giants" and led by sluice ditches to head boxes at the beginning of two 20-inch "mud lines," first passing through a grizzly made of bars set about 7 inches apart which held back the large stones. The mud lines crossed the river on a timber trestle 80 feet high and 230 feet long built for this purpose, then east over the top of the diversion dam and along the slope of the mountain at the north end of the dam. Just east of the diversion dam the line has a Y, and from this and the east end of the line are led two pipes, one for making each shoulder, laid along the "beaches" parallel to the axis of the dam. These beach pipe lines are lengthened or shortened by connecting on or taking off a pipe at a time, to continually change the point of discharge in order to insure a gradual and uniform building up of the beaches. Whenever flow becomes concentrated, sheer boards are used to spread it uniformly to prevent future sloughing of the shoulders.

The water flows into the central or core pool, where it deposits the clay for the core, and is then pumped over the diversion dam into an intake pool by the "core pool pumps;" being pumped from the intake pool to the hydraulic giants for use again.

An ideal condition for sluicing would be a uniform discharge all along the upper end of the beach. This discharge must not have enough velocity to carry the coarse material down into the core; and must not make channels at different places along the beach because these, with high velocity discharge, will create tongues or sloughing in the core.

As the flow runs down the beach, it is checked as soon as it strikes the water and the larger particles immediately sink and only the very fine ones remain suspended. The edge of the pool, therefore, deter-

(*Continued on page 58*)



North Side of Intake Pool. Mud Pipe Extends Along the Entire Slope, with Pipe Descending to Beach at Each End. At Left is Core Pool Pump House.

Sewage Treatment for Loomis Sanatorium

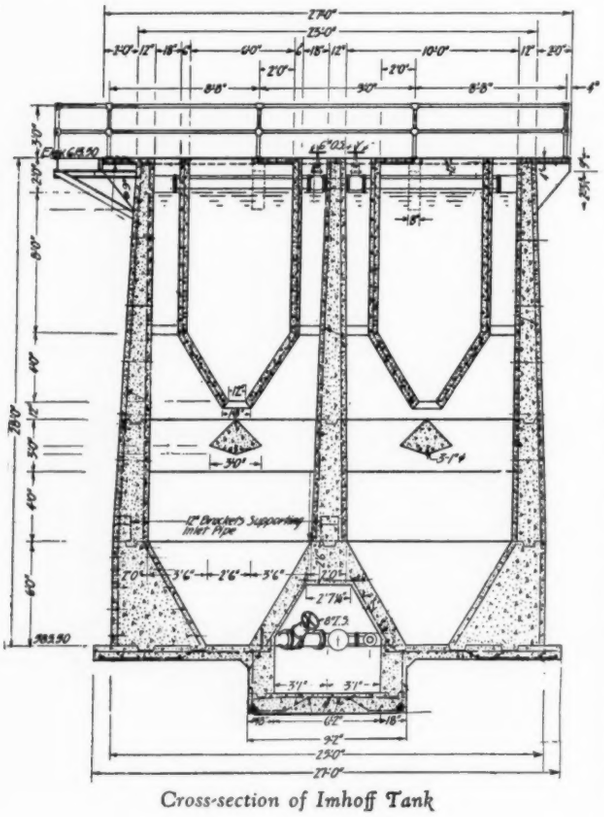
Small plant includes Imhoff tank without vertical sludge pipe, and with provision for flushing out sludge pipe with tank effluent.

CONTRACT has recently been awarded for a plant for treating the sewage of a sanatorium at Loomis, Sullivan County, N. Y., with a capacity based on a total population of 500 to 750; the effluent to discharge into a small stream that flows through the grounds. It is not expected that the total population (patients and employees) will exceed 500 for some years to come (it is now 415), but provision has been made in the present construction of the Imhoff tanks and the layout of the filter beds for a fifty per cent increase, which may occur in fifteen or twenty years. The maximum water consumption of the sanatorium does not now exceed 50,000 g.p.d.

The plant consists of screen chambers, two parallel Imhoff tanks, a dosing tank, four intermittent sand filters, and a sludge drying bed. Sewage is brought to it through 6-inch pipe, about 700 feet of which is of cast iron because laid below the hydraulic gradient; the rest is vitrified pipe laid with "Presstite" joints. A screen chamber is placed at the upper end of the "inverted siphon."

The screens in the screen chambers are made of ¼" x 1½" galvanized bars, set vertical and spaced one inch between centers.

Each of the two parallel Imhoff tanks is 10 by 15 feet inside, and 25 feet deep from water surface to bottom of hopper. The combined capacity of the two flowing-through compartments gives a detention period of 6¾ hours for 500 population, or 4½ hours for 750 population; while the sludge digestion hoppers have a capacity (below a plane 18 inches below the slot) of 5 cubic feet or 3½ cubic feet, respectively, per capita.



Cross-section of Imhoff Tank

There is no water under pressure at the plant to provide for flushing the sludge lines; but the sludge bed is 30 feet lower than the liquid surface in the tanks, and by means of a draw-down pipe and connections, and the valves on the inlet and outlet pipes, the sewage level in one tank may be lowered eleven feet and the resulting pressure developed by the difference in head in the two Imhoff tanks be used to flush the pipe connecting back from the main sludge line to the sludge compartment sump. This, of course, will be necessary only in case of stoppage of the sludge lines leading from the sumps.

A pipe gallery has been placed between the two tank hoppers and extending 3 feet below their bottoms. This eliminates the customary construction of bringing the sludge pipe up through the tank and horizontally through the wall six or seven feet below its top. Instead, a sludge pipe passes horizontally from the bottom of each hopper to the sludge main in the gallery, and the sludge is drawn off by opening a valve in this pipe.

The sludge bed has an area of 500 square feet, giving one square foot per capita for the assumed population.

The dosing tank, with four feet draft, has a capacity of 12,000 gallons, equivalent to a dose of 3 inches depth over a single bed. The maximum time of discharge, with allowance for inflowing sewage, will be about 32 minutes. The average rate of discharge will be about 535 gallons per minute, and 270 g.p.m. under minimum head on the siphons and a maximum rate of sewage contribution of 156 g.p.m.

There are four filter beds, each 6,100 feet square, or 0.14 of an acre in area; giving an operating rate of 89,300 gallons per acre per day for a population of 500, or 74,100 for the present population. The filters are to be 36 inches deep, composed of rigidly inspected sand of an effective size between 0.25 and 0.45 m.m. and with a uniformity coefficient of not more than 3.0. Payment for the sand is by the cubic yard as measured after settling during a month of service. The sand will drain through 6-inch vitrified pipe surrounded by gravel, graded into three sizes by screening through a one-inch and a ¼-inch screen and placed by hand, with the coarsest at the bottom and the finest on top.

The contract was awarded to E. W. Martin of Liberty, N. Y., at an estimated total of $43,373; of which the largest item was $11,020 for sand for the sand filters and sludge drying bed, and the next was $10,074 for concrete. H. Burdett Cleveland, of New York, is the engineer of design and construction.

Recent Progress in Water Supply

At the Annual Meeting of the American Society of Civil Engineers, reports were submitted by the various Divisions and Committees giving the status and progress made in the art of the various branches of engineering. Among these was a report on "Sanitary Engineering during the past few years as applied to the purification of public water supplies, treatment of sewage, refuse disposal, and air conditioning," prepared by C. A. Emerson, Jr., H. B. Cleveland, H. F. Ferguson, J. C. Pritchard and Robert Spurr Weston. That part of the report referring to Water Supply is given below in full; it is so concise a presentation of essential facts only, that no condensation seems to be practicable.

DURING the past year or so there has been real progress in that part of the field of water supply which includes improvement in the color, odor, and taste of waters, and in devising improvements in the art of water softening.

Color Removal.—Methods for the removal of color have been greatly refined. In past years methods other than storage depended largely on the unmodified treatment of the water with sulfate of alumina, with and without the addition of alkali, and preceded in some cases by treatment with chlorine.

In many cases where the iron content of the coloring matter is high, it has recently been found that super-chlorination followed by de-chlorination will greatly facilitate subsequent coagulation with the usual chemicals. This is because the chlorine oxidizes the organic matter which, with iron, largely constitutes the color in water. Certain kinds of color are difficult to coagulate and precipitate unless oxidized by storage or super-chlorination.

Chlorine in combination with ferrous sulfate, the so-called chlorinated copperas, has been used by Hedgepeth and his associates for de-colorizing the highly colored water at Elizabeth City, N. C. This chemical used as a primary coagulant and followed by treatment with sulfate of alumina and lime effects a marked reduction in cost of chemicals, besides producing a water of superior appearance.

At the Lawrence (Mass.) Experiment Station, Mr. H. W. Clark has shown that filters loaded with ferric hydrate are efficient for removing color. The direct addition of this chemical in practice is almost unknown, although it has been used experimentally by several investigators—most recently by Mr. Edward S. Hopkins with the turbid and colored Baltimore, Md., water. It will be recognized that ferric hydrate is the coagulating chemical formed when ferrous sulfate and lime are added to a water containing oxygen; it has been used for some time at St. Louis, Mo., New Orleans, La., Cincinnati, Ohio, and other places.

Increased economy in color removal has been effected by controlling the hydrogen-ion concentration of the treated water and by improved mixing and stirring devices. Through the use of the hydraulic jump, the Venturi throat, and impellers of pumps, chemicals are rapidly dispersed in water, and the slow velocities, so essential to the formation of well-dehydrated flocs in clear and colored waters, are procured by the use of mechanical stirrers and other basin arrangements. These modifications enable approach to the ideal decrease in velocity, roughly parabolic, between chemical application and filtration.

Filter Operation.—Progress has been made in methods for maintaining filters free from mud-balls in cases where high velocity washing at customary rates does not suffice. The use of air during washing has been of some benefit. Good results are obtained by washing the surface layers of the sand with water applied through a grid of pipes pierced with holes, and placed near the elevation of the surface of the sand when at rest.

Since 1928, a Committee of this Division has been considering filtering material for sewage and water treatment works, and experiments in small glass filter tubes have been conducted at various plants under the direction of James W. Armstrong, M. Am. Soc. C. E., of Baltimore, Md., to determine the optimum size of sand grains and the best depth and grading of sand beds to meet the requirements of waters of different types. No definite findings have resulted as yet from these experiments, but progress was noted in a paper recently presented by Paul Hansen, M. Am. Soc. C. E., at the Convention of the Southwest Water Works Association.

Recently, Messrs. Hulbert and Hering, of Detroit, Mich., in a paper presented before the Central Water Works Association, entitled "Studies on the Washing of Rapid Filters," demonstrated that clean sand is essential to uniform and normal filter operation, and that sand may be maintained in a clean condition by washing at a rate to produce a 50 per cent or 60 per cent expansion of the sand bed. Because the viscosity of water varies with the temperature, higher rates of wash-water application are required for higher temperatures. For example, it was found at Detroit that a wash-water velocity of 30 in. per min. was required to produce a 60 per cent expansion of a given sand at a temperature of 32 degrees Fahr.; a velocity of 45 in. per min. was required to produce the same result at a temperature of 70 degrees Fahr.

Messrs. Hulbert and Hering have shown that these high rates require little more, if any more, wash water in the aggregate; but before they can be applied, the sand must be cleaned. They use a caustic soda

(*Continued on page 64*)

Making the Road Money Go Further—II

Dustless Roads at Low Cost

By Geo. E. Martin
Consulting Engineer, General Tarvia Dept., The Barrett Company

TRAFFIC-BOUND types comprise the major portion of the road mileage which has been improved beyond the earth road stage. They vary from thin sand-clay surfaces to those having an appreciable thickness of aggregate ranging up to one or one and one-half inches in size. The very magnitude of the mileage involved makes any improvement in methods of maintaining such roads of vast importance.

Although the use of these types serves to get the public out of the mud, which is the first requirement of most local road systems, they all present a loose, shifting surface which must be continually bladed or graded if the road is to be kept in good condition. Where any considerable amount of traffic is present they are dusty, and the maintenance costs increase almost directly with the traffic. Binding material is blown away and larger aggregate thrown off the roadway, so that frequent resurfacing with additional

Patching Mix in Place

granular material is necessary. This may rapidly use up the available road building material in the vicinity so that costs go up, and eventually it may be impossible to obtain the additional gravel or other surfacing material without importing it at considerable cost.

Some sort of dust layer is usually the next move. These are of two general types, each depending upon the weighting down of the dust particles for its dust laying efficiency. Salts, such as calcium chloride, absorb water and keep the aggregate damp, thus tending to hold it down on the road surface. Light oils also weight down the dust particles in a similar manner. These dust layers are usually most efficient when first applied, and two or more applications per season are ordinarily used. The road still has a loose surface and the blading or dragging operations must be continued.

To meet the demand for dustless roads at low costs, methods for treating traffic-bound roads with bituminous materials have been developed. The methods have varied in different locations and with the different aggregates used in the original construction.

Low-cost traffic-bound types may be divided according to the aggregate used as follows—

Sand-clay
Gravel
  Coarse gravel
    (a) Tightly bound surface
    (b) Loose mulch surface
  Sandy gravel
Crushed stone
Crushed slag

Of the above, gravel has by far the widest distribution and the methods used for the surface treating of gravel may be considered typical of the other materials excepting sand-clay. Treatment of sand-clay roads has been briefly described in the preceding article and need not be repeated here.

Coarse gravel roads may be further subdivided into those which present a fairly tightly bound surface and those which are maintained with a mulch of loose material on the surface. We will consider the former class first.

Double Surface Treatment

Gravel roads of this sort do not have any appreciable amount of loose material on the surface. The gravel contains sufficient clay or other binding material to hold the mineral aggregate in place. The untreated roads are graded or dragged when wet or damp, but not ordinarily in dry weather. In fact, dragging when dry may seriously injure the surface. During prolonged drouth they become dry and dusty and begin to ravel under traffic.

The best time to treat such gravel roads is in the spring, after they have settled and before they have hardened. They should be smoothed with a blade grader, or drag, just before the treating operations. This is a very important operation, since the treatment will perpetuate the condition the road surface is in when it is treated. A good riding road will remain so, and unfortunately a rough road will also remain rough. All loose dust and other material should be swept from the road surface just prior to the first application of tar. The road is very tender after this sweeping operation and little or no traffic

Grading Loose Material for Mulch or Blotter Treatment.

should be permitted until after the tar has been applied.

This type of surface treatment is designed to get as much of the tar as possible down into the gravel, where it binds the aggregate together and forms a hardened crust rather than a mat or carpet-coat of appreciable thickness. The first or prime coat of cold refined tar is applied at the rate of approximately one quarter gallon per square yard. This is lightly covered with a coarse sand cover using about thirty cubic yards per mile of eighteen-foot road. This is immediately dragged with a brush or chain drag so as to smooth out the surface and assist in the setting-up action of the tar.

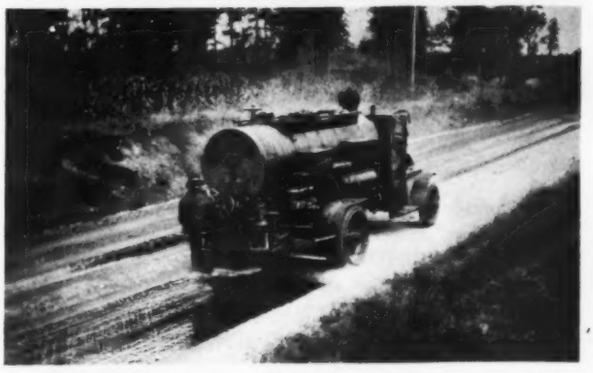
The second application of tar follows in about three days. Somewhat heavier material is sometimes used. This second application is also about one quarter gallon per square yard. The road should be swept lightly ahead of the second bituminous application to remove excess sand to the roadside. Coarse sand or fine gravel at the rate of 50 to 70 cubic yards per mile of road forms the cover for the second coat. The sweepings also are often graded back onto the road as a part of the covering material. This cover is dragged until it is bound down tightly under traffic.

A treatment of this sort is a maintenance operation and should be so considered. Gravel is rarely a uniform material, and due to this fact some breaks in the treated surface may show up very soon. These should be patched with a mixture of tar and sand, using about seventeen gallons of tar to a cubic yard of sand. Shallow breaks may be repaired by painting with tar and covering with coarse sand or fine gravel. Some patching may be necessary throughout the season, although the major portion of the breaks ordinarily occur during the first few weeks after the treatment. The mixed patching material can be stored for months in stock piles and used as needed. Curing is beneficial. Two barrels of tar per mile of road, per season, for patching is a fair average.

Whether or not this treatment will break badly the following spring depends upon drainage and other conditions underneath the surface. Its behavior will also be influenced by climatic conditions and by traffic. If only a small portion of the surface is broken, it can be patched and re-treated, using the methods described above for the second coat; the amount of tar needed being governed by the condition of the surface. If the broken area requires much patching, it will be cheaper and better to lightly scarify the surface and blade or drag the loose material into shape. In scarifying, the teeth should be set just enough to break the crust and not disturb the underlying material. It is now re-treated, using the same method as for the original treatment except that the amount of tar in the prime coat is reduced to about one-sixth gallon per square yard.

When well organized, this scarifying operation can be done at the rate of about ten miles per day, at a cost of about $10 per mile. Grading or dragging the loose tar chips and gravel before re-treatment may run this cost up to $75 per mile. The preparation and treatment, including labor, equipment operation, tar and covering material has been done under average conditions for less than seven hundred dollars per mile of 18-foot road.

(Continued on page 74)



Sweeping Before Application of Tar.

Applying Tar to Solid Material in Mulch or Blotter Treatment.

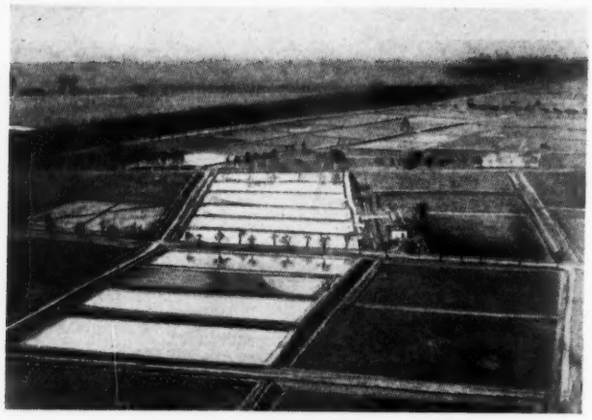
Spreading Covering Material from Truck. Using Brush Drag.

Spreading Seal Coat in Double or Mulch Treatment.

Sewage Disposal at Berlin*

The first of a series of papers to be contributed by the author, giving information collected by him during a recent visit to Europe.

By Willem Rudolfs
Chief, Department of Sewage Research, New Jersey Agricultural Experiment Station.



Sludge Settling Basins, Carolinenhohe

SEWAGE disposal at Berlin is gradually being changed because continuing the broad irrigation system would call for the expenditure of huge sums of money. A new experimental plant is being built at Stahnsdorf, where different types of sedimentation basins and aeration units are being compared.

Berlin has a population of 4,300,000 and covers an area of about 215,865 acres. About 140,000 acres of this area can be sewered. For the purpose of administration, the city is divided into 75 districts which contain a total of about 220,000 miles of sewers. In addition, there are also 745 miles of rain and storm-water sewers. The sewage coming from the houses is collected through lateral pipes into mains and forced to several disposal works by seventy-five main pumping stations and fifty-six additional boosting stations.

The main type of sewage disposal practiced in Berlin is by pumping the sewage to farms and using it for irrigation. In a number of instances the sewage has to be pre-treated before it can be used for this purpose. Berlin owns thirty-nine sewage farms, situated around the city at a distance of from six to twelve miles from the city limits, which cover an area of 68,000 acres, of which about 30,300 acres are irrigated. The total amount of sewage to be handled averages 170,000,000 gallons per day, with a maximum of 270,000,000. Most of this sewage is disposed of on the irrigation fields of the sewage farms. These are under the general direction of a farm manager and leased to individual farmers.

One of the best of the several farms visited was probably Carolinenhöhe. This farm receives the sewage of about 600,000 people and covers an area of 1,000 acres. The volume of sewage received daily is around 2,100,000 gallons. The farm is rented for about 100 marks per acre per year to a gentleman farmer, and out of the rent the taxes, construction and repair of roads, dikes and drainage ditches are paid. The actual operation, namely the switching around of the sewage on the irrigation fields, is under the direction of the farmer. The cost to the city of Berlin for the taxes, construction, etc., is about 75 marks per acre per year, which leaves only 25 marks per acre per year to cover cost of construction of the pipe lines and pumping stations for collecting the sewage, pumping it to the farms and the operating expenses, which sum is very inadequate.

A part of the farm is sublet to a number of peasants, who work from 1 to 50 acres each, but a good portion is kept by the gentleman farmer, who grows grass on the irrigated fields and sells it cut green to peasants who own one or more cows. From a scientific standpoint, little or nothing is known about the effect of the sewage on the farm land, whether soil sickness occurs or danger to public health exists. It has been established by practice that the irrigation fields must rest after having received the sewage for some time, and for that reason at least three times as much land must be available as can be irrigated at one time. The farming is done along practical, established lines under the direction of the gentlemen

Gas Collection on Imhoff Tanks, Wassmansdorf

*Journal Series paper, New Jersey Agricultural Experiment Station, Department of Sewage Research.

farmers, who as a rule appear to be good organizers and executors.

The sewage pumped to the farms cannot be used as such for irrigation, but must receive pre-treatment. In some cases it is settled in shallow, open earthen settling basins, in others in concrete tanks, and still others have more or less elaborate pre-treatment systems. At Carolinenhöhe the sewage is settled in both earthen and concrete open tanks with a detention period of from 1 to 6 hours. The basins are allowed to fill and then the sludge is conveyed to open stretches of land, where it is allowed to dry and later used as fertilizer. At this place no information was available about how much solids settled in the basin, but about 4,000 wagon loads of dry sludge per year are used as fertilizer.

The effluent from the settling tanks is conveyed through drainage ditches into irrigation ditches connected with the diked-in parcels of land. The irrigated parcels of land are about six-tenths of an acre in extent. These sections are under-drained with agricultural drain tile about 3 to 5 feet apart. The drainage water runs into deeper ditches until it all is eventually collected in a canal from 25 to 45 feet deep, and in this transported to the river.

The crops grown on the irrigation fields are principally grass, sugar-beets and vegetables. Grass is cut five or six times a year and fed green to cattle. Nothing is known about the possible diseases (typhoid, tuberculosis, etc.) which might be caused by this procedure. The combined sewage farms support about 70,000 head of milch cows, and in ordinary times about one-fifth of all the milk sold in the city of Berlin is produced on the sewage farms. All the milk is pasteurized. About one-fourth of all vegetables sold in Berlin are produced on the sewage farms, and as far as I could ascertain no definite precaution is taken or effort to ensure that all vegetables are cooked. The irrigated grass lands support about three milch cows per acre.

Due to the fact that the sewage can not be placed on the land without settling, the newer procedure is to have treatment plants where the solids are settled in one-story or two-story tanks, as is practiced at Wassmansdorf, which plant is in operation since July 1927. This system is employed for three main reasons: (1) To prevent clogging of the soil, (2) reduce the attendant odors, and (3) reduce fly nuisance.

One of the Main Effluent Canals, Carolinenhohe

Wassmansdorf

The treatment plant at Wassmansdorf consists essentially of coarse bar screens, two grit chambers, nine Imhoff tanks and a large collecting pump sump. The effluent from this plant is pumped from 6 to 7 miles to the irrigation fields.

Cleaning Sludge Settling Basins, Carolinenhohe

The coarse screens have one-inch openings and retain from 1 to 3 cubic yards of screenings per day. The grit chambers are equipped with traveling buckets for cleaning out the grit, and the sand is washed upon the drying beds. With this procedure, the sand contains only 8% volatile matter, and is used for filling in and making roads. The amount of sand retained daily is about 3 cubic yards or 3.75 cubic feet per million gallons.

The Imhoff tanks have a total digestion capacity of 837,000 cubic feet, or about 1.5 cubic feet per capita. The flowing-through time is about one hour and the flow is reversed at regular intervals.

The population connected to this plant is 560,000 people, with a total average dry weather flow of about 2,800,000 gallons, but the sewage is rather old and septic. A strong odor of H_2S is present around the plant. The sewage is strong and contains about 700 p.p.m. suspended solids, which have an average of 85% volatile matter content. The average sewage temperature is 56°F. and the solids are retained in the tanks for about 0 days.

The gas vents of the Imhoff tanks are covered and gas collected. The total gas production is around 70,000,000 cu. ft. per year, or a gas production of 0.34 cu. ft. per capita per day. The average composition of the gas is as follows: CH_4 72%, CO_2 18%, H_2 6 %, N_2 4%, H_2S 0.02% — 0.1% G. heat values 7000.

The effluent from the Imhoff tank is intensely black and foul smelling. The plant appears to be overloaded. To prevent too great a nuisance of odors, the sewage is

(*Cont. on p. 78*)

Growth in the Deep Drainage Ditch

On Right, 3½-Yard Drag-Line Throws Up Spoil Bank From Far Edge of Borrow Pit. Six-Yard Machine on Left Builds Most of the Levee. Finished Levee at Rear Center.

Levee Construction by Draglines

THE various methods of levee construction employed in the Reelfoot Levee District, just south of Hickman, Ky., about fifty miles south of Cairo, Ill., are of interest. The use of hydraulic dredges, with draglines for preliminary and finishing work, and of industrial railway equipment in "haul-in" work, has been described. This article describes a piece of work on which all the dirt moving was accomplished by the use of large draglines.

Contracts 7A and 7B, involving 465,000 cubic yards of levee construction, are located just south of Hickman, Ky. They involve the construction of new levee to replace a section threatened by the cutting in of the river just below Hickman. The average height of the new levee is 20.0 feet. The unit price on the work is 26 cents per yard, and 150 calendar days are allowed for completion. The contractors are J. H. Boyce & Bros. Co., and R. L. Igo.

The general method of handling this work is based upon the utility of the walking type of dragline. The required amount of earth for constructing the levee section is not available within easy reach, and considerable rehandling of the earth is necessary. Approximately one-third of the material is handled twice.

The equipment on the job consists of two Monighan draglines with 80-foot booms and 3½-yard buckets, and one 6-yard Monighan with 135-foot boom. All these are powered with diesel engines and have electric swings. Up to November 15, only two machines were on the job; at that time the second 3½-yard machine was added to expedite the work.

The general plan has been to have the 3½-yard machine open up the far end of the borrow pit—the earth must be taken from riverside borrow pits and cast toward the levee. Following this machine, the big 6-yard dragline takes from the spoil bank and, taking also out of the borrow pit, completes the general section of the levee. It is not able to finish in full the land side of the levee, which in this section has a base nearly or quite 200 feet wide, but this is accomplished by the smaller machine, which walks out around the levee, and back to the unfinished section, which it completes. When it catches up with the big machine, it steps out ahead and again throws up spoil bank from the riverside edge of the borrow pit.

The employment of draglines under the conditions prevaling in this job illustrates their many advantages when the character of the work is suited to them. And in this particular case, full advantage has been taken of the mobility of the walking type of machine. As a result, the work has been carried on with a minimum amount of equipment and at a good rate of speed.

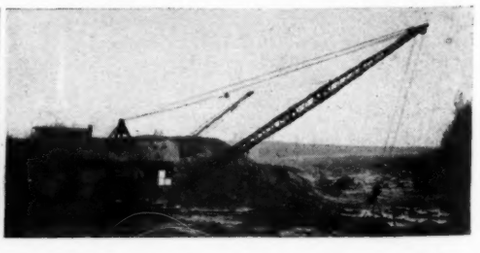
The only other equipment on the job consists of a couple of teams with a rotary fresno and a blade grader for dressing and finishing the levee, and a 5-ton Caterpillar "30" tractor which is used for pulling out stumps, hauling logs and stumps together for burning in the clearing of the borrow pit area, and on general utility work.

Less than 20 men are employed on the contract for both shifts. With these the work is progressing at a satisfactory rate.

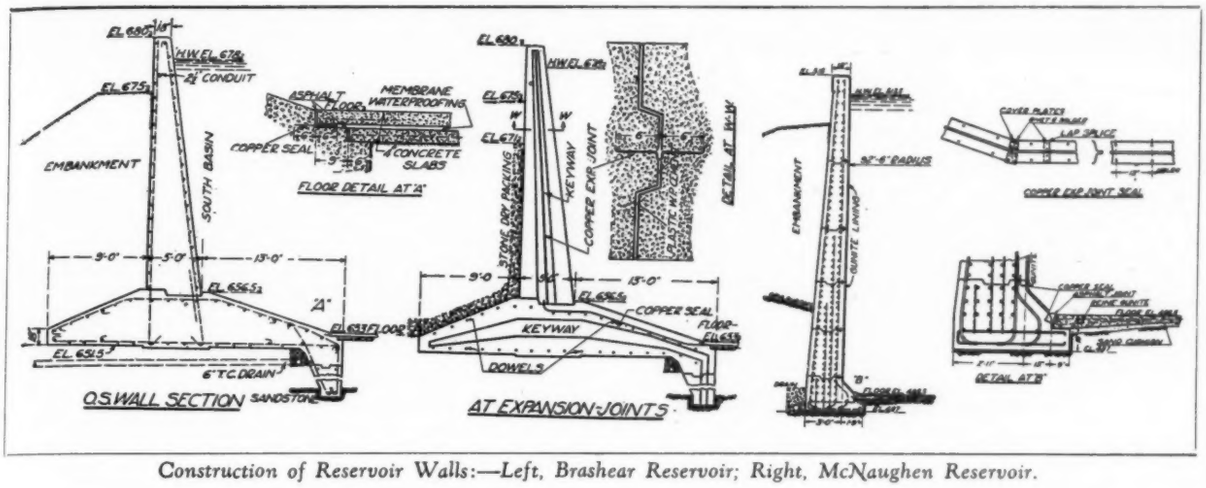
The work in the Reelfoot Levee District is under the general direction of the First Field Area of the Memphis Engineer District of the Mississippi River Commission. T. T. Knappen is Area Engineer. W. A. Steele is in general charge of the work, and H. T. Slade is inspector in charge of the district.

6-Yard Monighan Working in the Rain Depositing on Levee.

Taking Load From Spoil Bank.



3½-Yard Working From Borrow Pit. Condition After 3 Days of Rain.



Construction of Reservoir Walls:—Left, Brashear Reservoir; Right, McNaughen Reservoir.

Building Reservoirs Over Coal Mines

Grouting Cavities in Old Abandoned Workings to Strengthen Support of Reservoirs Required Twenty Percent of the Total Cost of Construction. Types of Construction Employed for Reservoir Walls, and Some of the Details.

PITTSBURGH, Pa., has constructed two reservoirs which involved unusual difficulties, and adopted very interesting methods for overcoming them. The chief difficulty was the danger of settlement due to the fact that the only places available for these reservoirs were found to be underlaid with old coal mines. These coal workings were believed to be at least 90 years old; no record of them could be found anywhere nor recollections of them among the oldest inhabitants.

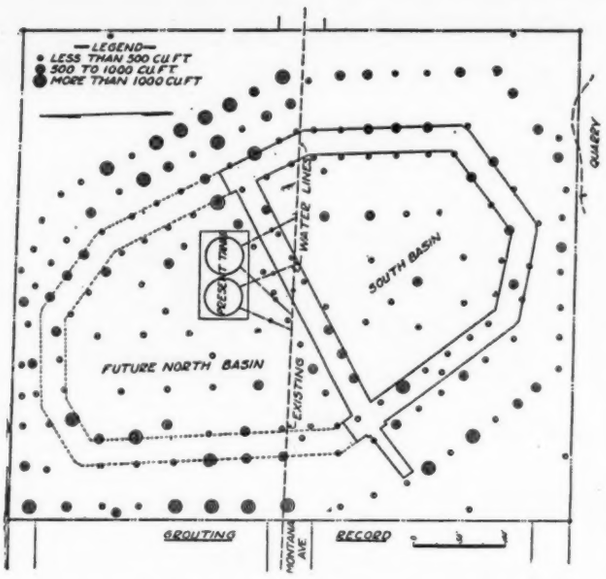
Another condition was that the sites selected were limited in area, while the city needed all of the storage capacity that it could obtain. For this reason steel tanks, which at first were considered because of the possibility of withstanding settlement of the ground without serious consequences, were finally discarded because they could not be made to furnish as much storage capacity as concrete reservoirs designed of a shape to utilize all of the available area, and the latter were adopted.

One of these, known as the Brashear reservoir, was designed roughly oval in shape so as to utilize practically all of the flat top of the hill, and with vertical sides, giving a full storage capacity of 23,000,000 gallons. The other, called the McNaugher reservoir, was located on a nose of land that seemed to be utilized best by two circular reservoirs, one much smaller than the other and to be used as a pressure regulator should the large one be out of service for any reason; the combined capacity being 5,500,000 gallons.

During the investigation of sites, core borings were made with diamond drills by the Pennsylvania Drilling Company. At Brashear the borings showed a heavy bed of rock about 60 feet thick between the floor of the proposed reservoir and the top of the coal horizon, this roof being mostly hard sandstone underlaid with more or less shale. Crevices in the sandstone roof indicated past movements in the rock. Below the rock were found large quantities of "gob"—a mixture of fine coal, slate and shale, material which would have been wasted during mining operations in which only lump coal was removed. All of the evidence indicated that a large part of the original coal had been removed and that the heavy roof had settled materially, with considerable cracking; and that there was, in the coal horizon, a considerable total of cavities more or less filled with gob.

The plan of running a number of columns from the wall of the reservoir down to the stratum below the coal was considered, but a more feasible and reliable plan appeared to be the grouting of the cavities in the coal and the crevices in the rocks above the coal horizon. Some experimental grouting was done using five of the 26 holes which had been drilled in the investigation work. One-to-three cement and sand grout was forced through the hole. After lowering the grout pipe into the mine, the space between this pipe and the drill hole was packed about 5 or 10 feet above the top of the coal, and the grout then pumped in under a pressure running up to a 100 pounds per square inch. When this cavity had been filled, the packer was loosened and the grout pipe raised to the approximate top of the rock, when the grouting operation was repeated, the grout or mortar in this case going into crevices in the overlying strata.

After this experimental grouting had been carried on in five holes, a shaft was dug adjoining one of the holes for the purpose of examining the nature of the coal mine and observing the effect of the grouting. At the bottom of the shaft old mine timbers were found and numerous cavities observed, but none of them very extensive. Some of the cavities were found filled with a mixture of mortar and gob, forming a sort of concrete. It was concluded that grouting with



Layout of Drill Holes. Brashear Reservoir. Number of Circles at Each Hole Indicates the Cubic Feet of Grout That It Took.

the cement mortar would stiffen up material adjacent to each drill hole, giving in effect columnar support at this point between the floor of the mine and the solid rock roof.

A contract was therefore let for drilling and grouting 193 holes, which were laid out so as to concentrate somewhat under the walls of the reservoir but also to support the floor and the rock immediately surrounding the reservoir. The contract provided for payment of a definite sum for bringing the contractor's plant onto the ground and removing it, to provide for any possible change in the program. To obtain relatively large holes at low cost, either churn-drilling or diamond-drilling was allowed, the contractor selecting churn drilling. Grout was paid for by the cubic foot of material applied. Contract for this work was let to the Pitt Construction Company, which used four churn drill rigs, and two portable air compressors with a combined capacity of about 400 cubic feet of free air per minute for forcing the grout; the compressors discharging into a receiving tank with a capacity of about 150 cubic feet, by which the air was delivered to the grout machine through piping and armored hose.

The grout-placing equipment consisted of two Union Iron Works pneumatic grout machines with agitator paddles driven by compressed air motors. In general, the two grout machines were used separately; but if a hole gave indications of requiring a large amount of grout, the two machines were attached to one hole so as to increase the probability of filling the space while the mortar was still in a plastic condition. If grout was found rising to the surface, as happened in two or three instances, grouting was delayed until the opening was sealed by the hardened mortar.

In order to bring as much pressure as possible upon the grout in the old mine space so as to fill the cavities as far as possible, the space between the drilled holes and the grout pipe was sealed in the first solid material above the mine space. After the mine space had been filled so that it would sustain an air pressure of 100 pounds per square inch, the 2-inch grout pipe was removed from the hole, and an upper packer was formed by bolting to the top of the 6-inch casing a blank flange containing a packing gland for 2-inch pipe. The 2-inch grout pipe was then lowered through the packing gland and the process of grouting the rock crevices was begun.

In grouting each hole, neat cement grout was used for the first few batches for the purpose of securing a greater penetration through the fine waste materials in the mine. If no back pressure was built up after a few batches had been placed, successive batches were made leaner until the limiting proportion of one bag of cement to 3 cubic feet of sand was reached. This relatively lean mix was used in most of the grout because of the large voids to be filled, but would not be suitable for filling fine crevices, where the sand would have a tendency to strain out and accumulate, finally clogging the entrance to the crevice. At several locations the grout was found to travel from 10 to 15 feet through crevices. In one instance it rose through a crevice in a stone quarry about 45 feet distant from the hole in which it was being forced. These observations and the quantity of grout that was placed indicate that the stability of the reservoir foundation was substantially increased by the grouting work.

The amount of grout used varied greatly. In some cases only enough could be forced in to fill the drill hole; while one drill hole received 2683 cubic feet of sand and cement. A total of 91,711 cubic feet was placed in the 193 holes, or an average of 475 cubic feet per hole.

The sub-surface under the McNaugher reservoir was substantially the same as under the Brashear, and grouting was performed in the same manner and by the same contractor, The Pitt Construction Company. Here the maximum amount of mortar placed in any hole was 2775 cubic feet. Eleven of the holes took more than 1,000 cubic feet each, 17 took between 500 and 1,000 cubic feet, and 75 received less than 500 cubic feet per hole.

The grouting work on the Brashear reservoir cost $76,255, of which $29,843 was for drilling and plant expense and $46,412 for placing grout. At the McNaugher reservoir the grouting work cost $26,905, of which $6,703 was for drilling and $20,202 for placing the grout. The total cost of the reservoir was $149,116. Only one half of the Brashear reservoir has been constructed at present and this half cost about $200,000. The foundation work for the Brashear reservoir was therefore 19 per cent of the total cost, and that of the McNaugher reservoir 22 per cent.

The designs for the two reservoirs differed considerably, although both were constructed of reinforced concrete. While two circular reservoirs were placed on the McNaugher site; on the Brashear, vertical walls in nine straight sections enclosed a roughly oval area. At the latter site the foundation material was very good and it was decided to use the T wall type because construction was simplified; fill could easily be placed on the outside of the wall; if settlement should occur, the heavy vertical wall as well as the footing slab would have sufficient strength to bridge considerable gaps without yielding; and every linear unit of the wall has the capacity to resist water pressure without dependence upon any adjacent units, thus localizing the effect of any settlement. The section was made unusually heavy, and in order to hold cracking of the concrete to a minimum, the tensile stress in the steel

(*Continued on page 80*)

County Highway Maintenance By Contract

The increase in speed of motor vehicles from 30 to 40 or 50 miles per hour, combined with the increased number, has necessitated more intensive maintenance and the use of more equipment or greater speed with the kind and number of equipment already in service. Like other counties in the country, Mower County, Minnesota, was faced with this problem in 1928. How it solved it is told in the following article.

By A. C. White
County Engineer, Mower County, Minnesota

IN 1928 Mower County had in operation two motor patrol graders owned by the county, which it found inadequate for properly maintaining its roads. In studying how to improve the service, it made an analysis of the operating of these units for the year 1928 and arrived at the conclusion that highway maintenance on non-rigid road surfaces involves smoothing the surface, replacing the surface, and snow removal; and that to supply machinery sufficient to perform each operation separately would require an investment of about $75,000. The county board therefore decided on equipment that would do all three operations. But even with this combination equipment, investigations showed that to furnish enough four-wheel-drive trucks to properly care for our 200 miles of state-aid road would necessitate the expenditure of approximately $55,000.

A cash outlay of this amount at this time seemed to be out of the question for the following reasons:

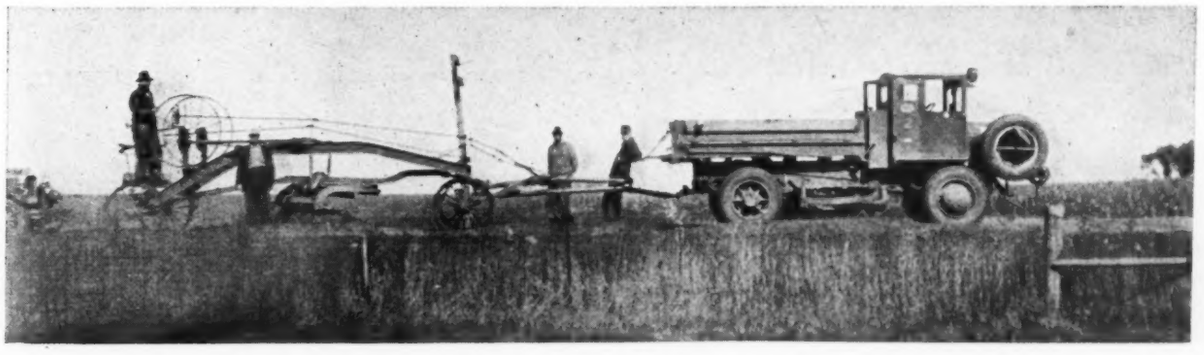
1. Lack of information relative to operating four-wheel-drive trucks for annual maintenance operation.
2. Our experience has been that a municipality cannot economically operate its own equipment.
3. Our budget was at that time in need of additional amounts for both construction and major surface replacements.
4. If any improvements were made in this equipment in the near future, we would not be able to take advantage of them. (Such radical changes have been made in the last few years that highway equipment two years old was practically obsolete.)
5. A county is limited by territorial boundaries in the operation of its equipment.

For these reasons we considered a manner of maintenance which had been given some thought for several years previous, namely, letting the maintenance by contract, and the writer was directed by the county board to draw up a set of specifications for contract maintenance. On the basis of these a contract has been let, which requires the use of the following equipment: Three unused standard make four-wheel-drive 3-ton trucks of 75 horse power or more, with a maximum speed of 30 miles per hour, and four forward-speed gear shifts; to be equipped with speedometer, recordagraph, yard box, power lift or hydraulic hoist, and pneumatic tires. One heavy-duty standard snow plow with snow wings. A 12-foot spring blade attachment, and one 15-foot blade grader. The contractor to furnish two men and all supplies and repairs.

The other equipment comprise a 60 h.p. or more continuous-tread tractor with a 12-foot cutting edge, leaning-wheel grader with scarifier, a V-type heavy duty power control snow plow with wings. Gravel hauling equipment, to include a portable belt conveyor and able to furnish a minimum of 6,000 cubic yards per year for maintenance purposes. Loading of gravel to be done at a contract price per yard.

A contract was let to L. H. Lull, of Rochester, Minnesota, and on May 18th, 1929, maintenance of the state-aid highways of the county by contract was begun. The work was divided into the following classifications:

1. Smoothing surface.
2. Drainage.
3. Structures.
4. Gravel hauling.
5. Weed cutting.
6. Snow removal.



Truck With Trailer Blade Used in Contract Maintenance in Mower County.

An estimate was given of the amount of each item to be done and the time allotments for doing the work. Under snow removal, an attempt is made to classify the time allowed for road closing, taking into consideration temperature, wind velocity, duration of storm, and precipitation.

The equipment used by the contractor was as follows: Three Coleman 3½-ton four-wheel-drive trucks, equipped with pneuhydro spring blades. Three Adams 12-foot graders with 3-foot extensions. One Sargent "Speedplow" without wings. One Sargent plow with widening wings. One Sargent heavy-duty plow with two widening wings. One Caterpillar "60" Snow Special with Adams 12-foot grader, also equipped with scarifier and back sloper. One La-Plant-Choate hydraulic snow plow. One 24-inch Pioneer gravel conveyor, 32 feet long. One Caterpillar "20" tractor for loading gravel. Total investment in equipment about $40,000.

When it is unnecessary to do any blading, as during the spring break-up, when dragging has no permanent benefit, all the units can be shifted to a gravel pit within an hour's time and start hauling gravel or rock. The pit is equipped with a portable belt conveyor and a Caterpillar "20" for loading. The six men on the units are sufficient to operate the pit and trucks without any additional help. The contractor is paid a unit price per yard for loading.

Cost Comparison

I have made a comparison of costs of the two systems, using the period from May 18, 1928, to December 1, 1928, when we were operating our own equipment and hiring teams, and for the same period in 1929 under the contract system. Included in the cost of motor patrols are both interest and depreciation, allowing 25 per cent annual depreciation. (As a matter of fact, we have had a 50 per cent depreciation, as we are not now using them.) It is needless to state that the trucks did a great deal more work than the teams and small tractors, due to both difference in width of blade and additional power.

In the first year's operation of any equipment that is entirely new to both contractor and engineer, faults are apt to appear, and this was found to be the case with us; but we hope that in 1930, with the knowledge gained, road maintenance under contract will be still more satisfactory.

I do not wish to give the impression in this article that contract maintenance has no faults. But much of the trouble that we have experienced has been due to the lack of detail in the specifications so as to clearly and concisely depict the operations, and this can come only by experience.

COMPARISON OF COST OF ROAD MAINTENANCE BY COUNTY FORCES FOR 6½ MONTHS IN 1928, WITH COST OF MAINTENANCE BY CONTRACT FOR 6½ MONTHS IN 1929.

(From May 18 to December 1)

Team and Motor Patrol Maintenance for 1928

Repairs of general equipment, 1928.	$1,579.20	
Costs on general equipment, 1929 ..	472.96	
Annual difference		$1,106.24
Interest on 27 graders, value $4,050, at 6%		243.00
Motor patrol No. 1, cost 1928, 6½ months		1,678.64
Motor patrol No. 2, cost 1928, year 6½ months	2,132.96	1,733.03
No. 1 operator's time, 6½ months, 1,433 hours		716.40
No. 2 operator's time, 6½ months, 1,240 hours		620.00
Time dragging, 1928, May 15th to Dec. 1st	19,802.79	
Erecting snow fence included in above	357.90	
Net		19,444.89
Total cost, 1928		$25,542.20

EQUIPMENT FOR 1928—19 patrolmen, 2 part-time 8-foot graders and teams hired, 5 tractors with 10-foot graders hired, and 2 motor patrols with 12-foot blades owned by county.

Contract Maintenance with Motorized Equipment for 1929

At the rate of $4.95 per hour.	
Trailer blade cost.....	$14,455.09
Spring blade cost.....	8,116.11
Graveling 23,452 C.Y.M.....	4,938.42
Loading 5,832 C.Y.....	1,431.00
Cost	$28,940.62
Amount of gravel hauled by teams.....	2,220 C.Y. or 4,500 C.Y.M.
Amount of gravel hauled by truck.....	5,454 C.Y. or 23,452 C.Y.M.
Difference	3,234 C.Y. or 18,952 C.Y.M.
Hauling 18,952 C.Y.M. at 19c	$ 3,600.88
Loading 3,234 C.Y. at 20c	646.80
Total cost of excess of 1929 gravelling over that done in 1928	$ 4,247.68
Amount 1928 maintenance	$25,542.20
Plus extra gravel value	4,247.68
Total	$29,789.88
Cost of 1929 maintenance	28,940.62
Net saving	$ 849.26
Annual insurance saving	300.00
Total saving	$ 1,149.26

CONTRACT MAINTENANCE SUMMARY

Trailer Blade:		
No. hours operated		$ 2,920.22
No. miles traveled		12,474.00
Cost		$14,455.09
Cost per mile	$1.16	
Rate of travel	4.27	miles per hour
Cost per hour	$4.95	
Spring Blade:		
No. hours operated		1,639.62
No. miles traveled		8,732.00
Cost		$8,116.11
Cost per mile	$0.93	
Rate of travel	5.3	miles per hour
Cost per hour	$4.95	
Graveling:		
No. hours graveling		997.6
No. miles traveled		9,628
No. cubic yards hauled		5,455
No. loads hauled		1,125
Cost hauling		$4,938.42
Cubic yard-miles		23,452
Cost per cubic yard-mile		$0.21
Loading cost per cubic yard (contract)		0.25

We have had the units working on snow removal for only a month and a half. The average mileage per hour for the month of January was 6.6 and our cost for that month was $2,510, including all units. Cost per mile was $12.50.

In addition to the information given in the above statement, we obtain what each unit does, for each is equipped with a recordagraph which records all stops, time of starting, time of stopping, the speed for each

(Continued on page 82)

The Unwashed Stone and Underdrains Showing Clogged Condition.

Washing Filter Stone At Liberty, N. Y.

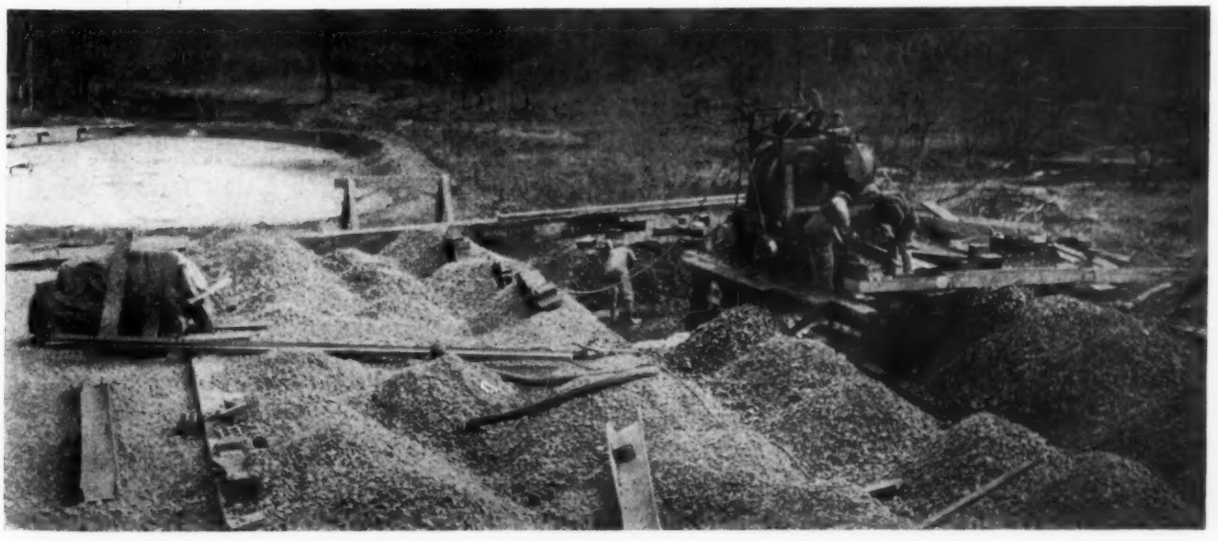
Stone from contact beds shoveled directly into concrete mixer, washed and shoveled back into the bed.

BECAUSE of continuous over-loading, the stone in the contact beds at the Liberty, N. Y., sewage treatment plant clogs rapidly. The plant, which consists of two septic tanks and four 40 by 90-foot contact beds, was built in 1892, and has been reconstructed several times since then. A description of it was published in *Municipal Journal* in the issue of Sept. 17, 1914. The contact bed stone was first washed in the spring of 1923, at which time some improvements were made in the plant. The washing, which cost $2 per cubic yard and improved the operation materially, was described in PUBLIC WORKS for November, 1923.

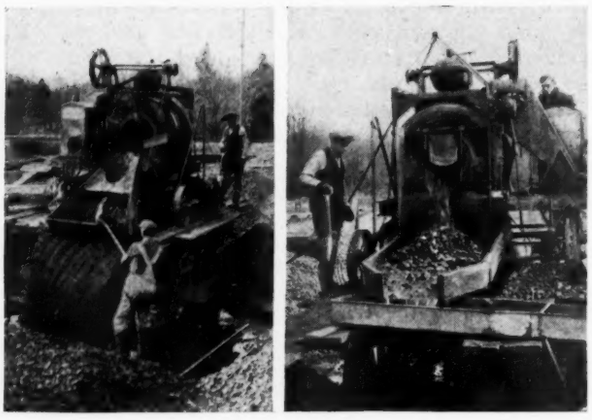
The working capacity of the contact beds, according to usual rates, does not exceed about 250,000 gallons per day, but the flow of sewage during the spring and summer months (Liberty is a summer resort) averages more than 500,000 gallons daily. The beds, therefore, are greatly overloaded, and, the septic tanks being overloaded also, receive a good deal of matter in suspension in the tank effluent.

Accordingly it was decided to wash the beds again to start the 1930 season. The equipment used in the work consisted of a Rex 7-S concrete mixer, mounted on a platform, as shown in the illustration; a power pump, and hand tools. An important part of the equipment were the small wheels on which was mounted the frame and platform carrying the concrete mixer. These provided the necessary mobility, without which operation was unsatisfactory.

Water was taken from the creek flowing past the plant by a small pump driven by an I. H. C. gasoline engine, and forced through a hose line to the mixer. The skip of the mixer was lowered, and 3 or 4 men filled it with stone by shoveling, the lift being about 4 or 5 feet from the floor of the bed. When full, the



General View of the Washing Operations, Showing Mixer at Work.



Left: Loading the Skip. Right: The Washed Stone Being Discharged From the Mixer.

skip was raised, dumped into the mixer, and water added. A dump board was provided at the rear to catch the washed stone, while the water ran off through a trough to the creek.

Two men with forks threw the washed stone to either side as it came from the mixer. Later the stone was leveled with horses and a scraper.

The cost of washing has run as low as 50 cents a yard on portions of the work, but has averaged around 70 cents—about one-seventh the cost of new stone in place. There is little loss due to washing.

The work is being done under the direction of the Board of Sewer Commissioners, of which Leslie Cooper is chairman.

Blast Furnace Slag for Trickling Filters

Conclusions from investigation made to learn results obtained by such use of slag

AN investigation to determine the suitability of crushed blast furnace slag for use in trickling filters has been made by Charles C. Hommon, sanitary engineer with the U. S. Public Health Service. Thirty-eight trickling filters were found in the United States in which slag was used as a medium. These all were studied, and their unloading ability compared with that of eleven filters which used other materials.

Samples of the several filtering materials were collected and their physical and chemical characteristics determined by laboratory tests. Operating data of the plants were obtained and tabulated. As a result of this study, a report has been prepared which states that the following conclusions are justified:

(1) The field investigation, in conjunction with sodium sulphate tests on samples collected from existing beds, show that crushed blast furnace slag is a durable material when employed as a sewage filtering medium.

(2) In a few filters, portions of the surface material had been affected by (a) flaking, (b) splitting and (c) true disintegration or crumbling.

(3) With the exception of one slag bed and one stone bed, this effect was not of sufficient magnitude to materially alter the size of the aggregate or affect operation of the filters. This conclusion is based on the fact that few pieces of slag were found to have failed by true disintegration, and that the flaking resulted in only a negligible quantity of fine material.

(4) When exposed to air and sewage, individual pieces of slag containing much metallic iron may ultimately disintegrate, due presumably to the rusting and consequent expansion of the iron.

(5) Blast furnace slag as commonly used for sewage filters does not contain a sufficient amount of metallic iron to be objectionable.

(6) Improper sizing and gradation were found in all types of filtering material. Absolute adherence to correct size limitations will prevent such a condition.

(7) The efficient equipment now employed in preparing aircooled slag is adequate to crush and screen the material so that it will meet any reasonable specifications.

(8) There was no evidence to indicate that crushed slag in the sizes now commonly specified for sewage filters will cement or consolidate.

(9) In the few instances where consolidation had occurred, it had been caused by excessive accumulations of fine material in localized areas, due to improper handling of the filtering material at the time of constructing the filters.

(10) There is no greater amount of organic deposits retained in slag filters than in those filled with other types of material.

(11) The rough texture of blast furnace slag does not prevent the periodic unloading of filters.

(12) Laboratory tests in conjunction with the field survey show that the suitability of a slag filtering material can not be determined by any of the following factors: absorption, specific gravity, weight per cubic foot, loss by abrasion or chemical composition. It is also believed that hardness, toughness and cementing value have no bearing.

(13) Slag filters effect a very satisfactory stabilization of the organic compounds in sewage.

(14) It does not appear that the type of filtering material has any direct bearing upon the development of the filter-moth fly.

(15) The field investigation indicated that sewage trickling filters (regardless of type of filtering material) would be benefited appreciably by controlling the amount of organic deposits retained in the filter. This can be accomplished by (a) periodic resting and drying, (b) flooding, or (c) chlorination.

(16) The information secured through this investigation indicates that crushed blast furnace slag is a suitable and desirable aggregate for use in sewage filters.

Contamination of Shell-fish by Sewage

Facts relating to the prevalence of endemic typhoid fever in Toulon show that, notwithstanding the improvement in the drinking water brought about by chlorination and ozonisation in recent years, the incidence of typhoid has still remained high. Many cases have definitely been traced to the consumption of raw mussels, and an examination of the effluent from the principal mussel parks of Toulon showed fæcal contamination to the extent of *B. coli* 1,000 to 275,000 per c.c.

Pre-Ammoniation at Springfield, Ill.

Results obtained during two years of use. Program adopted after preliminary experiments. Advantages of pre-ammoniation as learned by Springfield's experience.

THE water purification plant at Springfield, Ill. has been using ammonia as a preventive of chloro-tastes with very satisfactory results since February, 1928. Prior to that time, slight tastes associated with chlorination had given some trouble, although they usually were not sufficiently pronounced to cause serious complaints. However, soon after the beginning of the ammonia treatment the improved taste of the water was commented on by a number of the citizens.

Preliminary experiments in the use of ammonia, and the results obtained and the methods of application found to be most satisfactory, were described at considerable length by Charles H. Spaulding, chemist and superintendent of the Springfield Water Dept., in a paper before the Illinois Section of the American Water Works Assn. A brief abstract of the paper, omitting the tabulated and more detailed information, is given below.

The bacterial loads in the raw water at Springfield have been excessively heavy, and it was therefore important that nothing should be done to lower the efficiency of chlorination, but on the other hand everything possible should be done to increase it.

Laboratory tests made with river water indicated that pre-ammoniation ranks as an additional measure of purification, as effective in removing bacteria as other stages such as coagulation or filtration. But when lime was used as well as ammonia and chlorine, effects were not so satisfactory. Chlorine is found to work best at lower pH values, that is, without lime. The addition of lime slows the chlorine sterilization and the further addition of ammonia retards it still more.

From the experiments it seems evident that "the best time to apply chlorine is prior to the addition of lime. It is plain that if ammonia is used, a very marked increase in efficiency will result, providing the sterilization is complete before the addition of lime. It was not practicable to realize these advantages without considerable additional capital investment at Springfield, and they were not attempted.

"The next best procedure is pre-chlorination to allow the maximum period of contact. Ammonia can be used in small amounts provided the contact period is sufficient. If the ammonia permits higher chlorine residuals without taste, then the retarding effect may be more than balanced by the free use of the sterilizing agent.

"At Springfield, the nominal detention periods in the various stages of purification are as follows: Mixing chambers, 40 minutes; clarifiers, 1 hour and 40 minutes; settling basins, 4 hours; carbonating chambers, 30 minutes; filters, 30 minutes; clear well (full), 4 hours; nominal total, 11 hours 20 minutes. The actual flowing-through time may be much less for a part of the water or for all of the water under certain circumstances such as low clear well, or basin out of service. However, the plant is being operated at about 60 per cent of its capacity, so that the above figures should not be far from the facts on the average."

"It was shown by the preliminary experiments that no increased efficiency could be expected directly from pre-ammoniation at this plant, but if chlorine could be used more freely, then indirect benefits might accrue." Comparison was made between records in 1927-28 and 1928-29, an average of 2.9 pounds per million gallons of chlorine being used in the former period, and 6.1 pounds, including chlorinating the raw water, in the latter. The residual chlorine final was .18 p.p.m. in the latter period as against .12 in the former. The coagulant was reduced from 135 pounds per million gallons in the former period to 82 pounds in the latter; but the B. Coli found in the chlorinated water was only 0.25 per 100 c.c. in the later period as against 0.36 in the former, while B. Coli per 100 c.c. in the city tap water was 0.11 as against 0.12.

The chlorine consumption was increased due to chlorinating raw water and to the higher residual, but on the other hand less coagulant was used, and the net saving was 41c per million gallons treated, or 29c if the cost of ammonia is included. The time required for sterilization is indicated by the fact that the clarifier effluent during the latter period showed onl 33 per cent of the B. Coli index of the previous year; the water applied to the filters contained only 16 per cent of the previous year's index, while the filtered water contained only 5.5 per cent of the former figure. The final chlorination, however, brought the final effluent to practically the same bacterial condition during both periods.

The program which has finally been adopted with reference to chlorine and ammonia is as follows: Ammonia is added at the rate of 0.7 lb. per mil. gal. at the inlet of the raw water dosing well, where the detention is about 30 seconds. Chlorine is applied at the outlet of the dosing well in amount sufficient to produce a residual of 0.2 to 0.3 p.p.m. in the effluent of the clarifiers. As a rule, the residual drops slightly by the time the water has passed the filters, and additional chlorine is then added to bring the residual back between 0.2 and 0.3 p.p.m. If no drop has occurred, the second chlorination is omitted. As a rule, 1 lb. per mil. gal. is sufficient at this point.

The application of the ammonia has been made by solution prepared from anhydrous ammonia and delivered to the water from a small orifice below a tank holding 190 gal. of solution containing from 10 to 20 ibs. of the gas. However, the present practice is to apply the gas directly through a needle valve and a bubble meter consisting of a bottle of light oil through which the gas rises. In this arrangement the rate is

regulated by the number of bubbles per minute, 380 bubbles per minute being equivalent to 5 lbs. per day. The rate of flow is extremely constant, the valve frequently requiring no adjustment over a twenty-four hour period. The capacity of the device as at present is about 10 lbs. per day, which is the maximum and exceptional amount used. The ammonia tank stands on a scale, and the weight is recorded at regular intervals. The gas enters an alum solution line through which a small stream of water carries it into the dosing well. Whether or not the alum line is carrying coagulant is of no consequence.

Ammonia can be bought in many forms. Salts of ammonia could be applied from a dry feeder, but we have found the cost per lb. of NH_3 is less for either aqua ammonia or anhydrous ammonia, which are very nearly the same delivered at Springfield, namely 15c. per lb.

In view of the advantages which we have found in pre-ammoniation either for taste prevention or for increased efficiency where lime is not used, it seems that this useful addition to water purification processes should find wider application. The method employed formerly was to prepare chloramine solution before addition to the water, and this troublesome procedure probably prevented more general use.

Conclusions

1. Pre-ammoniation increases the efficiency of chlorination of water having normal pH value and low ammonia content.
2. Pre-ammoniation prevents chloro-tastes, including chloro-phenol tastes in a lime softening plant.
3. With high pH values, considerable time of contact, as much as eight hours, should be provided if maximum sterilization is required.
4. Ammonia is simply and cheaply applied with no undesirable after-effects necessitating special vigilance.
5. Chlorine residuals sufficient to overcome subsequent contamination are feasible when ammonia is present.

Durango's Water Supply

Durango, Colorado, has a population of about 8,000 and is a typical western city, being (according to the "Mueller Record") the largest town in the San Juan basin, which is claimed to be richer in natural resources than any other area of equal size on earth; while the climate, the productivity of the soil, the scenery, and the people combine to make it the most desirable place in which to live; the coal found within the basin is said to be the highest grade west of Pennsylvania, and there is an abundance of natural gas and the wells yield the highest gravity oil yet discovered. Last year they completed the finest water works system in the United States.

Previous to 1929 the water system was inadequate. In March 1929, a bond election for water works was carried with a majority of about five to one, for the purpose of carrying out plans designed by A. L. Kroeger at a cost estimated at $350,000. The new works consist of a reservoir on a high mesa about 350 feet above the city; the replacement of wrought iron mains, where they were used in the city, with cast iron; and cast iron pipe in place of a previous wood-stave pipe leading from the city to the reservoir. The contract for doing the work was let on April 18th, to Wood, Morgan and Burnett, local contractors; and that for the DeLaval cast iron pipe to the Hendrie and Bolthoff Mfg. and Supply Company of Denver. Construction was begun late in April and the system was in operation on November 3rd—thought to be good time when it is considered that 11 miles of the mains were laid in a rough, mountainous country.

The most interesting feature of the new plant is the intake. A dam reaching to bed rock was built across the Florida river, and a cut-off wall extending beyond the river channel. Five lines of perforated galvanized pipe were buried beneath the river bed up stream from the dam and wall and covered with selected porous material. These pipes collect the underground flow and deliver it to a 20-inch cast iron line. Mr. Kroeger believes that this system will take care of a population of at least 15,000, and by spending $30,000 for additional storage reservoirs will take care of a population of 30,000.

"Excuse It, Please"

In our May issue we quoted from a contemporary the remarks attributed to one who had suffered from the propinquity of a noisy steam shovel. Even the steam shovel probably cannot compete in penetrating, nerve-racking noise with the riveting of a modern steel building. The contractors who occasion these noises are not always, or perhaps often, insensible of the discomfort which they occasioned to the neighbors. One in New York City showed his appreciation of what the noise meant to those living in the vicinity by erecting in front of the lot on which the building was rising an artistic sign, on which was painted the words:

OUR SINCERE APOLOGIES
TO OUR NEIGHBORS
FOR THE UNAVOIDABLE ANNOYANCE
THIS HAMMERING MUST OCCASION.

With the completion of the building, this sign was replaced by another:

THE LAST RIVET
HAS BEEN DRIVEN.
WE, TOO, ARE GLAD.

A number of other builders throughout the city have considered the idea a good one and erected similar signs.

This is only one of a number of ways in which contractors, during the past decade, have shown a desire for the good will of the citizens. Among other evidences of this are the much more sightly fences and other boardings placed in front of construction operations, over sidewalks for protecting pedestrians, etc., than were formerly seen, many of which are even painted in neat colors so as to be as little offensive as possible.

The telephone exchange is not the only place where courtesy is considered to be a business asset.

Sewage Disposal for Norristown

Plans for a sewage treatment plant for the Borough of Norristown, Pa., which is estimated to cost about $250,000, have been prepared by Remington, Vosbury and Goff and submitted for the approval of the State Department of Health. The borough has recently completed two trunk sewers, one 12-inch sewer about 3600 feet long and one 10-inch about 3800 feet.

Machine Finishing for Asphalt Pavement In California*

The use of mechanical means for spreading, raking and finishing hot asphaltic mixture for highway and street paving.

By C. S. Pope
Chief Construction Engineer, California Division of Highways

THE information presented herewith was obtained over a working period of about three years, during the construction of some 250 miles of asphaltic concrete surfaced highways and thousands of square yards of city streets.

The advantages which have become apparent and the improvement in asphaltic construction which have followed upon the introduction of mechanical spreading and finishing have been summarized as follows:

(1) Removal of limitations on plant capacity due to inability to handle large tonnages on narrow highways.

(2) Decrease in unit costs of asphaltic mixture, due to quantity production and quantity handling on the street.

(3) Greater uniformity of structure of the asphalt paving base and surface.

(4) Decrease in surface roughness to a point where there is now little difference between the best laid asphaltic type and any other type of pavement in this respect.

(5) Production of a uniformly smooth non-skid surface which will be safe in any weather for a number of years.

(6) Elimination of poor workmanship through the substitution of machinery for hand labor on all of the more important phases of the work.

(7) Reduction in rolling due to the particular arrangement of the paving mixture previous to rolling.

(8) Decrease in plant and street costs due to mass production, and decrease in general contract costs due to speed of operations as a whole.

The purposes first sought in the use of such machines were several:

It was desirable to increase the amount of material which could be handled on the road beyond what was possible by hand spreading. Plant capacity could be increased by building larger plants, and hauling equipment could be handled on the road, but it did not seem possible to place enough shovelers and rakers on a 20-foot road to handle the greatly increased tonnage required for economical work. In other words, the spreading and raking operations constituted the bottle neck of the job.

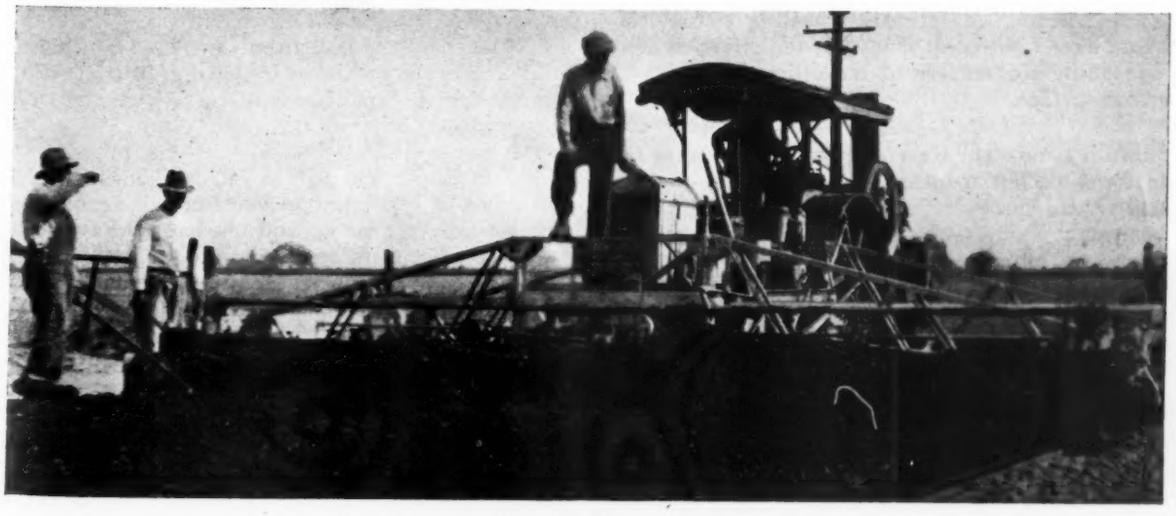
It was desirable that smoother pavements be laid, because of the unfavorable comparison which constantly arose between portland cement concrete pavements smoothly finished by machine methods and asphaltic pavements still finished by hand raking.

It was desirable that a non-skid surface be constructed which, while smooth, would still afford as safe driving in rainy weather as was claimed for the portland cement concrete.

It was desirable to incorporate in the pavement construction such qualities as would insure a long life and freedom from objectionable waviness.

In the matter of plant capacity, it may be said that common practice in California at the present time has fixed on plants producing from 2,500 to 5,000 pounds per batch as the economical size. Such a plant will

*Condensed from paper presented at Eighth Annual Asphalt Paving Conference. See also paper by the same author in PUBLIC WORKS for September, 1928.



Finishing single-course asphalt concrete in California

Spreader Boxes. Trucks on This Job Handled 9½ to 10 Tons of Material per Trip

turn out up to 65 batches per hour, if properly arranged, and average outputs of from 500 to 800 tons per day are not unusual. While our specifications limit output to 65 batches per hour, the number may be increased should our laboratory and field investigations indicate that improved methods introduced by the contractor will produce a satisfactory mix in a shorter mixing cycle.

Spreader Boxes

Two usual types of spreader boxes are in common use, one of which is equipped with skids on which it is dragged forward and the other is supported by means of rollers. Both are equipped with more or less satisfactory gates extending the full width of the back to permit spreading the mixture to the proper thickness. Some difficulty is experienced in making the ribbons of mixture deposited by the spreader boxes lap over each other without rock pockets developing. One of the best methods to secure this result is to cut holes about six or eight inches square in the ends of the spreader box near the front of the box which will allow sufficient average mixture to run out to make the junction of the ribbon satisfactory.

We have found spreader boxes economical and satisfactory whenever a uniform thickness of surface of considerable depth is to be spread. Some contractors claim little saving where a surface less than 3″ loose is to be spread. In spreading leveling course, contractors have resorted to numerous ingenious methods of spreading the surface of the course parallel with the true surface.

Side Forms and Rails

Since it is now our common practice to require that side forms be left in place, such forms are of wood, usually three inches in thickness and as deep as the pavement.

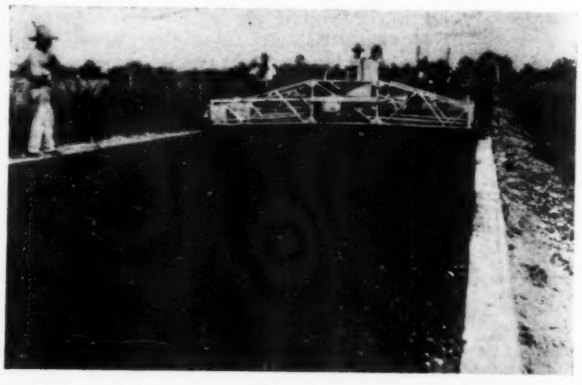
They are supported on hubs at four foot intervals and are securely staked to prevent lateral movement. We require all forms to be surfaced on both edges. While it is quite possible to spread base or leveling course from the wooden side forms, it is not possible to spread surface with spreading machines as at present designed.

It is necessary to make an allowance for compression, and for this purpose it is common practice to lay flat steel rails about ¾″ to ⅞″ in thickness by 2½″ to 3″ in width on top of the wooden side forms to elevate the finishing machine a sufficient distance above the side forms to allow for compaction during rolling. These rails usually have a V-shaped or tongue and groove connection with each other to preserve alignment and are about ten feet in length. Usually three or four sets of rails are sufficient on the average job, as they are taken up and moved ahead as the work progresses. It is usual to nail the rails temporarily to the side forms.

Finishing Machines

Two types of finishing machines are now in use in California, both of which will spread, rake and finish asphalt concrete. Both types of machine are motor driven and consist essentially of front and rear screed plates set about 10 feet apart, having a motion transverse to the pavement at the same time that the machine advances along the side forms. The raking elements are set in between the screeds and consist of steel pins set in heavy pipe as described elsewhere.

We require not only spreading, but also raking and respreading by the rear screed on all of our work and in this respect our practice differs somewhat, I



Finishing Machine, on Asphalt Concrete, Traveling Directly on Concrete Curbs

believe, from other localities where spreading only without raking is a usual practice. Since we have not tried our machines on sheet mixtures, I am unable to say from actual experience whether raking of these mixtures is essential with a screed machine, but from a large experience in laying sheet asphalt by hand methods, I would consider raking such surfaces as essential as raking asphalt concrete.

The two types of rakes mentioned, and which I will designate as the pendulum type and the sliding type, represent the different ideas of the manufacturers, but they perform similar work.

The rake teeth, which consist of steel pins from 8″ to 14″ in length and ½″ to ⅝″ in diameter, are set six inches or less apart in two lines of double-thickness pipe of two to two and one-half inches nominal diameter. The teeth are adjustable for projection and are fixed in place with set screws. The rake assembly extends the width of the machine, 10, 15, 20, or 30 feet as the case may be. The essential difference in the two types of machine now in use is the method of raking used.

In one machine, the rake teeth swing with a pendulum motion in opposite directions, which stirs up the mixture in line with the direction of travel.

In the other machine, the entire rake assembly slides backward and forward between guides, the teeth plow-

(Continued on page 88)

Highway Improvement in Arkansas

Work done on four-year construction program, by contract and by state forces.

Arkansas inaugurated a four-year highway construction program in July, 1927, under what is known as the Martineau Road Law. In reviewing the work done under this law during the first two years, Dwight H. Blackwood, chairman of the state highway commission, stated that work on the state highway system entirely completed or under contract represented an expenditure of $38,900,000. During these two years the department completed or awarded contracts for constructing 6,223 miles of various types of roads and approximately 24 miles of bridges, exclusive of eight toll bridges projected. The 931 bridges which go to make up the 24 miles of bridge were contracted for at a cost of approximately $7,060,000.

This large number of bridges is made necessary by the fact that Arkansas has the greatest mileage of navigable streams within its boundaries of any of the states—more than two thousand miles exclusive of the Mississippi.

Of the 6,223 miles of road work, about 3500 miles consisted of grading and drainage work necessary for the construction of permanent highways, about 2,500 miles was gravelled road (1500 miles completed and the remainder under construction), and 300 miles was high-type concrete pavement.

The state itself does considerable highway construction and maintenance work and owns and operates a large number of tractors of various types, motor graders and maintainers and heavy-duty trucks, over 1000 pieces of equipment being owned by the state. To care for this equipment the state has erected at Little Rock a general repair shop and warehouse with a floor area of 15,000 square feet. Also at each of the ten district headquarters there is a small repair shop in charge of a district mechanic where minor repair and maintenance work is performed.

The revenues for the highway work are provided for by license fees and gasoline taxes, and these have proved to be sufficient and are increasing at the rate of $1,000,000 a year. The motor vehicle registration in 1929 was 233,033 and the revenue from license fees was $3,850,000; while that from the gasoline tax (at 5c a gallon) was $6,610,690.

Above—Heavy-Duty Motor Truck Delivering Gravel on Highway Near Glenwood.

At Right—Crushing and Screening Plant in Bed of Caddo River Operated by McCormick-Deering 15-30 Tractor

Mosquito Control on Water Supply Reservoirs

A clean reservoir the first essential. Varying water level, minnows and larvicides.

IN a paper with this title presented before the North Carolina section of the American Water Works Association, Ernest W. Constable, chemist-biologist of the Bureau of Sanitary Engineering, State Board of Health of North Carolina, gave some suggestions for water works superintendents. He stated that our worst malaria-carrying mosquitos choose the quiet, warm, sweet water of ponds and reservoirs, although some will produce in bodies of water of other kinds. In the surveys of towns for the breeding of mosquitoes, water supply reservoirs have been found to be among the heaviest producers.

Up to the present, the methods of control of mosquitoes have been devised mostly for situations other than water supply ponds. Methods more suitable for reservoirs will undoubtedly be devised, but in the meantime some methods can be employed effectively and without objectionable results.

The first essential in the control of mosquitos is maintaining a clean pond. Mosquito larvae require protection, which they find in vegetation, debris, and flotage which usually collects in ponds. A clean, free pond area offers them little place to hide and, although eggs may hatch, the larvae have little chance to mature. There are, however, a number of sections in most reservoirs in which it is not economically feasible to bring about and maintain sufficient exposures to prevent breeding. Such sections occur in

(Continued on page 92)

Water Works and Purification Plants Constructed in 1929

Work done last year by the cities of several of the states, from information furnished by the state boards of health.

Indiana: New works were built during 1929, all drawing their supplies from wells, at Laurel, Medaryville, Monroeville, Morgantown, Ossian, and Schneider, now in operation; and in Carmel, Cynthiana, New Harmony and Westfield which had not been completed at the end of the year.

Improvements to existing plants were completed during the year as follows: La Porte, an iron removal plant.

Rochester, a well as substitute for untreated lake water.

Speed, a filter plant.

Winamac, a well as substitute for untreated river water.

And the following were under construction at the end of the year: Hobart, settling basin, filter plant, and elevated tank. Indiana Feeble Minded Colony, settling basin and filter plant. Indiana State Reformatory, settling basin and filter plant. Marion, softening and iron removal plant.

Maryland: Annapolis, 4½ m.g.d. filtration plant under construction.

Luke, West Virginia Pulp and Paper Co., began new 12 m.g.d. filtration plant to replace smaller one supplying towns of Luke, Md., and Piedmont, W. Va.

La Plata, population 500, water supply system from drilled well, untreated. The legislature passed bills providing for filtration plants at Maryland Training School for Boys; for water works at Springfield State Hospital, Mt. Wilson, Smithsburg and Sharptown; and for extension and improvements at Montrose School for Girls, Crownsville State Hospital, Charlotte Hall School, Frostburg, Funkstown, and Pocomoke City.

Massachusetts: Chatham and Southboro, works under construction.

Metropolitan District, Ware river tunnel under construction.

Springfield, Cobble Mt. reservoir under construction.

Willbraham, works constructed for taking water from old Ludlow works of Springfield.

Michigan: Blissfield, pop. 2,000. Temporary rapid sand filter; permanent plant to be built during 1930.

Bridgman, pop. 250. Water distribution system.

Mt. Clemens, pop. 11,000. Rapid sand filters.

Saginaw, pop. 75,000. Complete rapid sand filter plant, with softening and recarbonation. Beautiful and complete plant in every respect.

Also under construction: Clio, pop. 1,300. Distribution system.

Detroit, pop. 1,500,000. Filter plant of nearly 300 m.g.d. capacity, to be finished in 1931.

St. Clair, pop. 3,600. Rapid sand filters, to be finished in 1930.

Missouri: Construction completed: Ozark, water system, ground supply.

St. Louis, water purification; coagulating and settling, gravity filter and chlorination.

Wellsville, water system, surface supply; coagulating and settling, gravity filter and chlorination.

Under construction: Bagnell dam project, water system, ground supply, chlorination.

Harrisonville, water system, surface supply; coagulation and settling, gravity filter and chlorination.

Norborne, water system, ground supply.

Poplar Bluff, surface supply; purification plant, coagulation and settling, gravity filter, chlorination.

Rolla, new well.

Plans approved for ground water system at Sweet Springs.

Bonds voted for water systems at Belton, Platte City and Warsaw.

Mississippi: Deep wells, no treatment, at Fulton, Houston, Mendenhall and Vaiden.

Brookhaven. Added aeration and lime treatment to remove CO_2.

North Dakota: Belfield, Beulah and Hebron installed systems, with well supplies, no treatment, costing $35,000, $25,000 and $59,000 respectively.

Oklahoma: Wells, pumps, mains and elevated tank at Gould ($54,845), Blair ($25,000), Davidson ($23,000), Hydro ($30,000), Meeker ($25,533), Fletcher ($32,100), Binger ($25,000), Fargo ($19,000), and Arnett ($20,000). Also same with pressure Zeolite softener at Strong City ($25,000). Gravel-treated wells, pumps and Zeolite softening plant at Leedy, $22,100. Settling basin and filters at Hominy, $12,386. Well, pumps, reservoir and flow line at Erick, $100,000. Gravel-treated wells and mains at Hammon, $27,500. Gravel-treated wells, reservoir and flow line at Waurika, $52,000. Collecting system, pumps, dam, reservoir and flow line at Hollis, $48,900. Dam, settling basin, mechanical mixing basin, filters, chlorinator and flow line at Tecumseh, $115,000.

South Dakota: Elk Point, iron removal plant on well supply.

Yankton, coagulation, settling, filtration and chlorination of river water.

Mitchell, coagulation, settling, filtration and chlorination of lake water (not completed last year.)

Castlewood, water works system, shallow well.

Texas: Brackettville, system from spring, chlorinated.

Dallas, plant for aeration, coagulation, sedimentation, filtration, recarbonation and chlorination.

Del Rio, additional reservoirs.

Friona and Valley Mills, well supplies, no treatment.

Oklaunion, storage and pump pit.

Rio Grande City, plant for coagulation, sedimentation, filtration, aeration and chlorination.

Smithville, settling tank.

Sweetwater, plant for aeration, coagulation, sedimentation, filtration and chlorination.

Sewage Treatment Plant for Corning

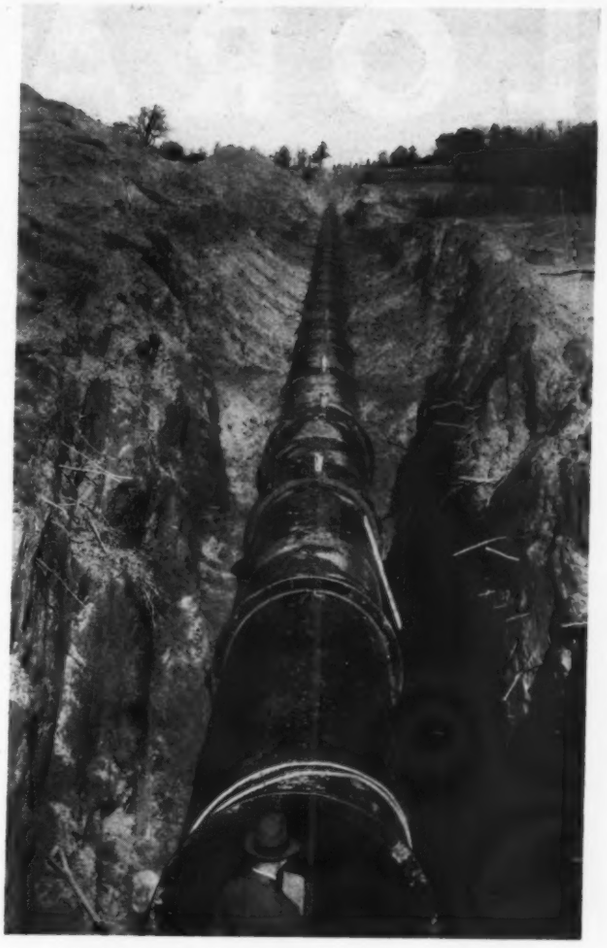
The city of Corning, N. Y. has let a contract for a sewage treatment plant which is estimated to cost about $90,000, consisting of a pumping station, Imhoff tanks, sludge drying beds and a chlorination plant. The State Department of Health recommended the construction of this plant in order to eliminate serious pollution of the Chemung river, which flows across the southern part of the city.

Albany's New Water Supply

Six million dollar project includes twenty miles of forty-eight-inch cast-iron pipe and several reservoirs

WORK is now almost completed on the new water supply for Albany, N. Y., to replace its present supply—filtered water from the Hudson river. This project is of especial interest for a number of reasons. The size of the project, involving an expenditure of more than $6,000,000 is unusual for a city of the size of Albany, especially so since there are no by-products, such as the sale of electric power, to be realized from the project. The construction of a 48-inch cast-iron pipe line 20 miles long across a rough country and under numerous railway tracks and creeks, is a construction project of much interest to engineers. The fact that a city, situated on a great river, finds that it is no longer economically possible to secure satisfactory water from that river, but must go back into the hills for it, is perhaps an indication that pollution of many of our streams has reached a point beyond the capacity of present-day purification processes to cope safely and economically with it.

The source of the supply is Hannacrois and Basic creeks, on both of which reservoirs have been constructed. The Basic creek dam is little more than a diversion dam, though the reservoir has a potential area of about 265 acres. From this reservoir a tunnel has been driven through the hills to carry the water into the Hannacrois creek watershed, where a reservoir with a capacity of nearly twelve billion gallons is formed by a dam across Hannacrois creek, located at Alcove. From the dam, the water is carried 8 miles through a 48-inch cast-iron pipe line to the filter plant, whence it passes through another cast-iron line 12 miles long to the Albany distribution system. To the north of the city (the new supply lies to the southwest) will be constructed a new distribution reservoir with a capacity of 100 million gallons.



Line of Pipe, Partly Backfilled, Showing Leadite Funnels

Elbow, with Concrete Thrust Block

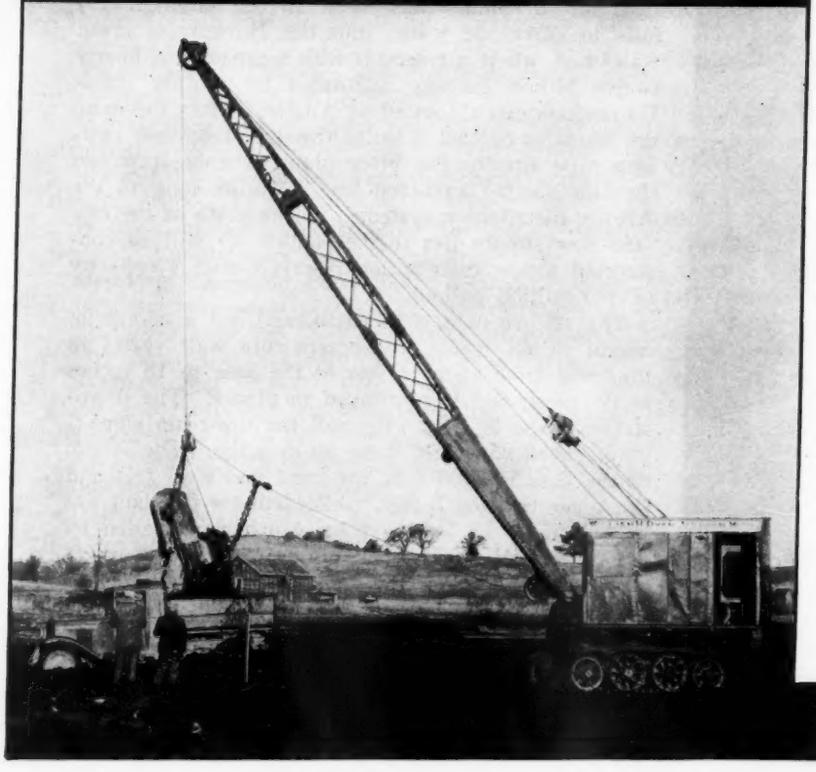
The Alcove dam is of earth, and has a maximum height of 68 feet. A concrete core wall varies in thickness from about 4 feet at the base to 18 inches at the crest, and is reinforced in places. The downstream slope is 1 on 2½, and the upstream slope 1 on 3, paved with field stone set on edge. The length of the dam is 2400 feet, the crest width 15 feet and the superelevation 7 feet. All earth for the dam was hauled in by 15 Mack trucks, which were loaded by 3 Erie shovels, the earth being secured from borrow-pits near the ends of the dam.

The spillway is located at the east end of the dam, but discharges through a saddle into the stream some distance below the dam. The spillway crest is at ele-

(*Continued on page 111*)

LORAIN 55

THEW



IT'S fast. In 10½ seconds the Lorain 55 crane will pick up a load, travel 11½ feet, and swing the boom around to dumping position. The Center Drive enables the operator to put the machine through three operations at one time. And each operation is under independent control.

Built to the greatest specification a shovel or crane can have—the Center Drive. This means that power, speed, ruggedness are BUILT IN.

THE THEW SHOVEL CO.
LORAIN, OHIO

12½ ton Crane • 1 yd. Shovel • Clamshell Dragline • Backdigger • Skimmer Scoop

Extended rocker arm crawler for clamshell, dragline, backdigger, crane operation.

THEW CENTER DRIVE

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THE EDITOR'S PAGE

Importance of Water Supply Engineering

As a business, as spenders of money, the water supply departments and companies of the country do not loom up so large as do the sewerage activities, and are completely overshadowed by streets and highways. The data which we have collected indicate that the annual expenditures for sewerage total two to three times as great as those for water works, while construction and maintenance of streets and highways require about five times as much.

As to their relative importance to us as a nation, it might be claimed that highways are of the greatest importance to our commerce and industrial functions and one of the agents of our world dominance in these departments.

But when it comes to our personal health and comfort, and to the diversified knowledge and technical skill involved, waterworks certainly is far in the lead of highways, and probably of sewerage also. Consider the engineering skill required in designing and constructing dams, aqueducts, tunnels and other important structures; the intimate knowledge and judgment needed for estimating quantities required for many years ahead, and selecting sources of supply; the chemical, biological and physical knowledge required for selecting the best method of treatment for giving a safe and agreeable supply, and the familiarity with latest details of structures and procedures; the acquaintance with mechanical and electrical machinery and devices called for in selecting and installing pumping plants; and the ability of superintendents to handle men in the field and women (as complaining consumers) in the office; to please politicians in the city hall and directors or taxpayers in the annual report; surely these many diversified abilities are not required in either of the other fields of public endeavor.

It is unnecessary to more than mention the vital importance of waterworks men in protecting and promoting the health and comfort of the nation.

The fact, therefore, that our water works statistics in this issue are less formidable in volume than those relative to highway work in the March issue is no indication that the subject is, or is considered to be, of less importance. Reference to the table of contents will illustrate the points referred to. Here we find descriptions of work of unusual importance or difficulty in dam and reservoir construction; in the laying of large mains; latest procedures in treatment of water; ingenious methods of developing supplies; and reports on water works progress in general.

That waterworks men take seriously the importance of their work and of their obligations as guardians of the public health is proved by the high standing and large membership enrollment of the American Water Works Association and the many state and sectional associations, and by the character of the papers and discussions at the meetings of these societies and at the "courses" given by a number of the state universities. In these respects we believe that no other class of engineers surpass those engaged in water works practice.

The Census and City Planning

To the average citizen, the population figures of the census are of interest chiefly as satisfying his curiosity concerning the growth of his city, and its rank in size compared with others in the state or the country. But to the municipal engineers and other city planners these figures are of real importance. They are their guide in planning for the future as well as for the present; in calculating the per capita typhoid rate, water consumption, amount of different polluting matters contributed by sewage to the streams; in estimating how long it will be before an increase in the water supply will be needed, or in the capacity of the sewage treatment plant. As the figures of each decennial census become available, they give an opportunity to check up on the assumed rates of growth of the several cities, which have been used as a basis for planning the development of municipal utilities of all classes.

These men, therefore, are interested in the accuracy of the census figures and in their availability as promptly as possible. An error of five per cent in counting the population of a city may mean an error of twenty-five to fifty per cent in calculating its decennial rate of increase, and its probable population at the end of the thirty or fifty-year period for which plans are being made. And the lack of the latest figures or delay in obtaining them, necessitating use of those taken ten years ago, may lead to equally large errors in planning.

Promptness in making the figures available is second in importance only to their accuracy, and it is to be hoped that the Census Bureau will, in this respect, give us the service which we have learned to expect from the Bureau of Public Roads.

Airports as Public Utilities

So recent has been the development of air navigation and the construction of airports and especially of those built, owned and operated by the public, that the idea of such public ownership is received by many with surprise and questioning as to its advisability or legality. Fortunately the state courts seem to be in quite general agreement on the legality of this practice as serving a public purpose. Even such use of land held for park purposes is as justifiable as its use for baseball grounds, tennis courts, etc.

The issuing of bonds for purchase of land and construction of airports theron is as much within the power of a city as for other general public purposes. That airports are not specifically mentioned in a city charter or state constitution does not exclude them from the general powers and rights relative to public or municipal purposes; for airports have developed since most charters were drawn up.

These and other related points, which are being included in the consideration of almost all cities throughout the country, have been passed on by many of the state courts, and their decisions are abstracted elsewhere in this issue.

Preventing Flood Damage to Roads

Losses due to inadequate precautions in designing and construction. Riprap, cement and sand in bags, and other prevention methods.

By J. F. Coleman
Chief Engineer, So. Region, Nat'l Paving Brick Mfrs. Ass'n.

THE constantly increasing amount of damage done to our highways by floods, with the attendant economic losses to traffic and business, emphasizes the necessity for very careful planning of future roads and bridges, and the adoption of permanent preventive measures for protecting those already constructed.

Conditions contributory to higher stages of water, because of quicker run-off, are constantly increasing and make it necessary to provide for even greater floods than those which have yet occurred. It is not sufficient to design roads at crossings of streams on the basis of the greatest floods that have occurred but we must consider what is likely to happen throughout the entire future. The cost of the few additional feet in height or length which would be necessary to give complete safety to a bridge or a fill is usually negligible, if added at the time of construction, compared to that which would be required for readjustment after its completion. A structure built for permanence should be made permanent for fifty, one hundred or even five hundred years in the future, and not be a source of present worry and future expense.

This applies not only to major crossings but to minor drainage problems as well; for it is a common sight to see a road flooded or made impassable by a stream which is normally only about five or ten feet wide.

In view of the fact that air travel may some day balance the traffic increase, engineers are not justified in assuming that increase of traffic in the future will necessitate reconstruction of a road in any event, and that future drainage conditions may be met when that new construction is undertaken.

That adequate provision for floods is not made at the present time is demonstrated by the innumerable cases of blocked and damaged roads throughout the country during the past year. Whether the road is following an old location and existing grade or whether it is new construction on a new route, careful and expensive research concerning drainage should be undertaken and nothing left to chance or taken for granted. In both the location of the road and the construction of the foundation, as well as the drainage, the road should be planned with the idea of lasting forever. Although it may be an unimportant road now, the time will come when it will demand a better wearing surface and then extensive reconstruction will be avoided.

Financial conditions are often controlling influences in design and construction, the idea being to get as many miles as possible for the money available. Frequently the designing and constructing engineer has no choice but must produce a given number of miles for a given amount of money and use his talent to give the public the best results possible under these conditions. But a road subject to being blocked by water is a liability, hampering traffic and causing expense and worry. Diversion of money from new projects to readjustment of old ones should receive consideration of highway departments; it might impress upon the financial heads the importance of adequate designing and construction.

The damages caused by water flowing over a road or standing for long periods near the top are not always apparent immediately after the water has receded, but serious conditions may develop long afterwards. Such conditions include marked subsidence, especially of new fills, which may appear months later, dropping of the base away from the pavement in rigid types of surfaces, and carrying elastic types down with it as it settles. Either case calls for major and difficult repairs. Waving and rutting of light asphalt pavements will be a gradual development, starting soon after the water has gone down and extending approximately throughout the area inundated. In the case of surface treatments, water enters the fine cracks usually not vulnerable to rains, softening the sub-grade, which works up through the cracks and severs the asphalt bond and prohibits rebonding. Raveling results immediately thereafter. Under all types of pavements, saturated sub-grades freeze and heave in winter, with consequent rupture and failure.

Overflow on traffic-bound roads usually results in a rapid loss of the surfacing, thereby more quickly exposing the sub-grade to attack, after which the fill material soon disappears.

It is noted that a high percentage of trouble occurs at bridge ends during high water. The primary faults here are improper design of end bents and abutments, or inadequate protection of slopes by riprap, both chargeable to remissness in construction. These can be remedied usually by proper protective measures.

Overflows at very small drains, or where none exist at all, are often occasioned by local heavy downpours or cloud-bursts and back-water from large streams. If the road has a heavy, impervious, rigid pavement and water remains on it for a short time only, slight damage usually is experienced, the worst feature being blocked traffic. However, if there is a swift current or the water stands for a long period, some of the fill and pavement may be lost.

Methods of Protection

At points where the overflow occurs, down-stream slopes should be rip-rapped sufficiently far down from the shoulder line to take care of the difference in head between the up-stream and down-stream stages. This will represent the distance of fall on the down-

(Continued on page 113)

Socony Cold Patch constructed by State Forces at Glenmont Bridge, Albany County, N. Y.

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Standard Asphalt Binder A
for surface treatment

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for penetration work

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for the mixing method

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STANDARD OIL COMPANY OF NEW YORK

Small Louisiana City Installs Drainage System

By E. B. Johnson

WEST MONROE, Louisiana, has just completed ditching operations on a municipal drainage system that is noteworthy for several unusual features, including its low cost. This city, with a population of 8,000, is situated on the west bank of the Ouachita river. The surface drains away from the river with a grade of about eighteen inches to the mile. A cypress bayou brake along the western outskirts of the town has always hindered drainage; in fact, after long and heavy rains it has not been uncommon for water to flow from the brake into the city. The situation has been bad from the standpoint not only of general drainage but also of mosquitoes and malaria.

To remedy these objectionable features, the city has ditched the brake from its junction with the river, some two miles below the town, to the northern edge of town, with three main feeders into this ditch from three sections of the city. Small ditches leading into these feeders have been dug, and the whole has been functioning so well, in spite of an extremely wet season, that West Monroe is now one of the best drained cities in the state. It is planned to convert the open feeders into covered drains as the need arises.

The main brake was in reality a heavily wooded cypress swamp. During a period of dry weather some weeks in advance of the ditching, a right of way fifty feet wide was cleared and all large stumps split with Hercules 50% dynamite. The ditching was done without any further preliminary work with a 1½-cubic yard gasoline-driven Northwest dragline mounted on crawlers. It was necessary in several places to corduroy for the drag-line to prevent it from sinking into the mud. Logs were provided from the swamp, and a mat of about 50 feet was maintained. This was taken up by the machine and moved ahead as necessary.

The entire system of between four and five miles was ditched in about sixty days, working 24 hours a day, seven days a week, to avoid backwater which covered the entire area shortly after the ditching was completed. Over the entire period an average of 62 yards of excavation per hour was maintained, including all delays. This very high rate was possible because of the speed of the dragline and the efficiency of the operating crew.

Ditches were from six to twelve feet deep, from six to twelve feet wide at the bottom and were dug with one-to-one slope on the sides. Excavated dirt was so placed in piles that in no place was water prevented from flowing into the ditch. An average grade of 2 feet to the mile was secured. The dragline cut so accurately to grade that refinishing or trimming of the ditches was not necessary.

The Midland Construction Company of Clarksdale, Mississippi, did the work by contract at a unit price of 13.25 cents per cubic yard of dirt moved, all necessary clearing and stump splitting and also eight wooden bridges being included in this price. About 90,000 cubic yards of excavation were involved. The total cost of the system was about $17,000.

Highways on Federal Lands

In the western states there are large areas of public lands which are held by the United States. Because of these lands (as is generally well known) a larger amount of federal aid for road construction is allotted to the states in which they lie than to the other states which contain no such areas of federal land. This aids the state in the construction of roads reaching private and state lands, but there is urgent need for the construction of highways across the federal areas to serve as connecting links in interstate highways, as well as to aid in promoting the use of some of these federal lands for the purposes for which they were intended. At its 18th annual convention, held recently, the Chamber of Commerce of the United States adopted a resolution that congress should make suitable provisions for the federal government to construct these highways on its own lands at its own expense.

The Chamber of Commerce also endorsed a recommendation of the 16th International Conference of American States (meeting at Havana in Cuba two years ago) that the several countries of the Pan-American Union should take steps immediately looking to the construction of a great inter-American highway, and it urged that the government of the United States give every fitting cooperation to the other governments of the Pan-American Union in its realization.

Main Ditch through Cypress Brake

One of the Feeders. Note slope of sides and clean ditch.

Dragline in Operation Digging a Feeder.

Water Mains Laid in 1929

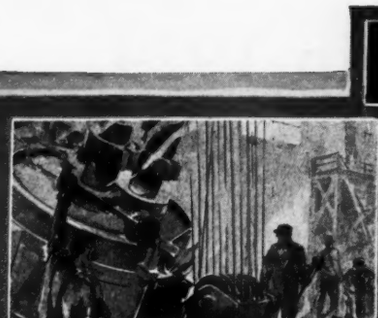
Figures from water works officials of three hundred cities, giving amount of pipe laid of the several sizes and different kinds of materials, and the amount in service at the end of the year

Cast Iron Pipe Laid in 1929

City and State	Under 6-inch	6, 8, 10 and 12-inch	Over 12-inch
Alabama:			
Decatur	4,500	4,720	....
Arizona:			
Tucson	246	2,866	....
California:			
Oxnard	5,221	3,210	....
Redlands	10,524	....	....
Sacramento	4,316	26,180	2,263
Colorado:			
Trinidad	1,384	....	4,536
Connecticut:			
Hartford	19,448	57,492	929
Putnam	340	....	9,780
So. Manchester	1,000	3,700	....
Torrington	....	7,160	4,523
Willimantic	....	1,500	....
Florida:			
Orlando	....	25,000	....
Idaho:			
Burley	600	1,000	....
Preston	4,300	....	....
Twin Falls	5,500	20,821	....
Illinois:			
Bloomington	2,600	5,350	73,000
Lake Forest	6,000	....	5,000
Oak Park	....	7,060	....
Quincy	293	8,283	....
Rockford	....	27,718	3,565
Rock Island	....	3,580	....
Waukegan	....	1,908	....
Wheaton	....	100	....
Indiana:			
Brazil	720	2,550	....
Columbia City	....	460	....
Connersville	132	12,613	....
Knightstown	1,100	....	....
Logansport	....	3 miles	....
Nappanee	516	....	....
Peru	....	4,650	....
Richmond	60	11,964	....
Rushville	....	1,289	....
West Lafayette	292	9,293	....
Iowa:			
Burlington	48	17,270	....
Carroll	820	2,450	....
Cherokee	....	1,550	....
Council Bluffs	1.34 mi.	3.36 mi.	....
Dubuque	738	14,883	....
Marshalltown	2,000	....	400
Mason City	902	6,000	100
Oskaloosa	715	....	....
Ottumwa	....	4,340	....
Red Oak	1,000	200	....
Sioux City	8,708	32,872	....
Washington	1,200	....	....
Kansas:			
Coffeyville	400	300	....
Osage City	2,700	....	....
Kentucky:			
Hazard	1,800	....	....
Louisville	....	97,455	49,407
Providence	....	2,500	....
Louisiana:			
Rayne	5,000	22,250	....
Maine:			
Augusta	2,425	2,850	....
Maryland:			
Frederick	1,200	....	14.500
Washington Suburban Sanitary Dist.	4,089	69,792	10,955
Salisbury	....	9,500	....
Massachusetts:			
Adams	2,000	....	....
Belmont	350	8,459	....
Brockton	....	7,800	10,770
Danvers	116	18,200	....
Dracut	....	1,627	....
Dudley	....	1,800	....
Fitchburg	4,058	3,048	....
Framingham	....	8,628	....
Malden	190	3,726	....
Marlboro	....	0.3 mi.	....
New Bedford	151	7,971	....
North Adams	....	2,187*a*	....
Spencer	....	1,450	....
Springfield	497	35,018	23

City and State	Under 6-inch	6, 8, 10 and 12-inch	Over 12-inch
Massachusetts (Continued)			
Stoneham	....	4,400	....
Swampscott	2,122	....	....
Turners Falls	500	950	....
Waltham	....	11,333	....
Webster	....	5,860	....
Westfield	....	4,792	....
Williamstown	125	....	....
Winthrop	....	10,470	....
Worcester	65	30,140	978
Michigan:			
Coldwater	139	2,478	....
Dearborn	....	59,009	5,267
Detroit	....	397,516	113,817
Gladstone	900	800	....
Hancock	....	600	....
Hastings	300	....	....
Midland	....	4,000	....
Mount Clemens	....	6,393	....
Niles	700	4,500	....
South Haven	2,735	....	1,264
Minnesota:			
Cloquet	....	176	....
Duluth	....	5,063	....
International Falls	2,280	....	....
Minneapolis	....	30,000	2,000
Mississippi:			
Jackson	....	67,000	15,600
Missouri:			
Jefferson City	....	6,000	....
Liberty	850	....	....
Poplar Bluff	1,200	....	800
Richmond	700	....	....
St. Louis	7,286	172,867	422
Montana:			
Billings	....	9,137	5,042
Bozeman	409	5,207	....
Kalispel	....	365	....
Nebraska:			
Crete	....	1.5 mi.	....
Fremont	....	3,790	....
Lincoln	....	2.34 mi.	....
Plattsmouth	500	....	....
New Hampshire:			
Claremont	....	1,063	....
Keene	....	8,797	....
Lebanon	1,200	558	....
Manchester	167	13,214	4,499
New Jersey:			
Belleville	....	4,463	....
Bridgeton	....	4,332	....
Hawthorne	2,500	....	....
Irvington	....	1,400	....
Madison	1,500	11,500	....
Milltown	....	6,820	....
Ridgewood	....	24,435	....
Woodbury	....	4,000	....
New Mexico:			
Raton	1,000	....	....
New York:			
Binghamton	245	6,948	....
Canton	....	1,200	....
Ellenville	....	1,400	....
Elmira	72	14,653	1,038
Haverstraw	....	9,000	....
Herkimer	....	....	18.5 mi.
Hoosick Falls	10,000	0.5 mi.	....
Lancaster	641	300	....
Little Falls	....	1,449	....
Mt. Vernon	....	23,574	....
Saugerties	....	356	....
Syracuse	....	51,984	4,872
Utica	....	12,760	280
Waterford	490	....	....
North Carolina:			
High Point	13,262	29,991	11,033
Rocky Mount	4,267	10,975	....
Winston-Salem	3,300	44,500	3,600
North Dakota:			
Fargo	....	1,232	....
Grand Forks	....	4,523	....
Ohio:			
Akron	11,880	175,450	34,280
Barnesville	....	500	....
Bucyrus	2,738	....	....
Defiance	288	2,600	....

(*Continued on page 50*)



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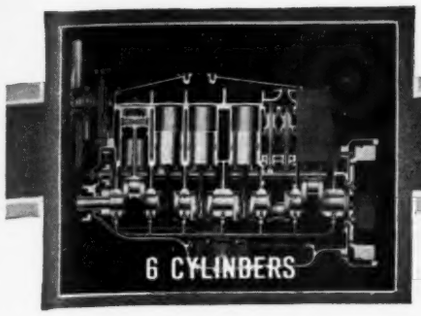
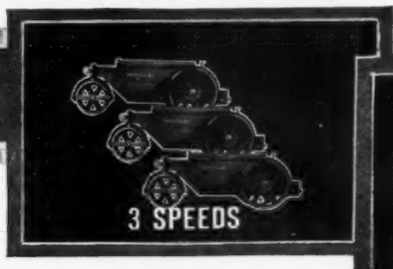
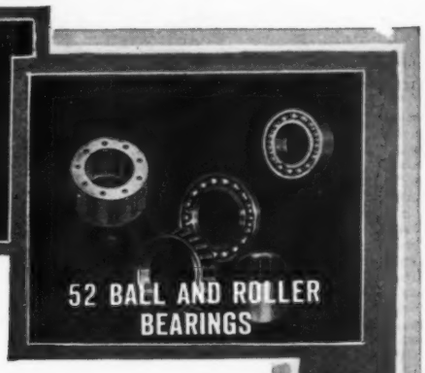
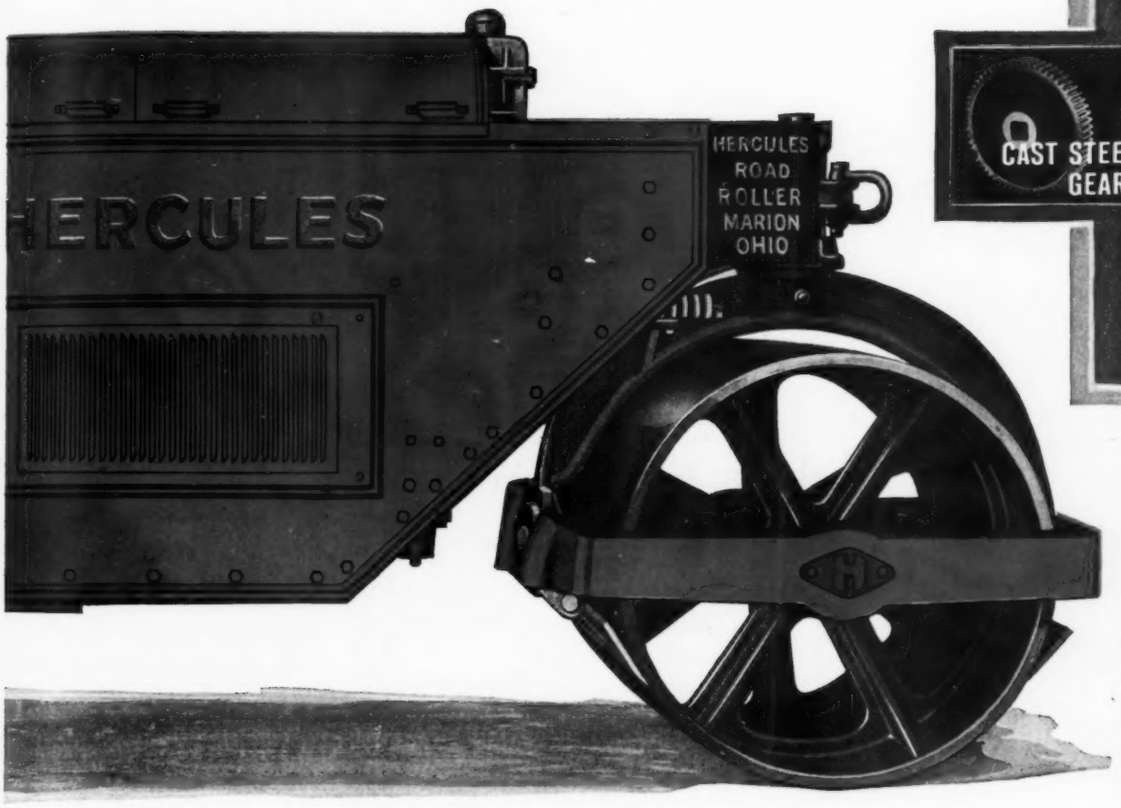






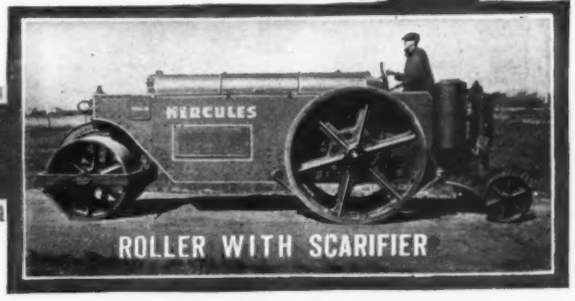
OF HERCULES



LONG-SERVICE ROAD ROLLER

power, ball and roller bearings throughout—fifty-two of them, all gears and clutches enclosed and running in a bath of oil, one lever for forward and reverse motions, seventeen hundred pound drawbar pull—the most powerful roller built. There isn't a rolling job it won't handle better, cheaper and faster. Introduced this year, and already specified by six State Highway Departments. Its on the biggest contracts this year. Sold by the leading Contractors' Equipment Dealers.

COMPANY
Osgood Company
OHIO



For latest catalogs—consult the *classified* INDUSTRIAL LITERATURE section, beginning on page 119

Cast Iron Pipe Laid in 1929

City and State	Under 6-inch	6, 8, 10 and 12-inch	Over 12-inch
Ohio (Continued)			
East Cleveland	445	17,336	....
Elyria	....	6,730	....
Gibsonburg	....	300	....
Lancaster	891	5,757	....
Lima	1,960	684	....
Medina	3,500	....	....
Mingo Junction	....	1,658	....
Montpelier	....	300	....
Niles	3,500	800	800
Orrville	380	....	....
Sylvania	1,000	....	....
Warren	13,800	5,000	....
Wilmington	....	1.300	....
Youngstown	30	20,700	6,500
Oklahoma:			
Henrietta	....	1,400	....
Newkirk	2,200	....	....
Stillwater	2,800	....	....
Oregon:			
Marshfield and North Bend	2,500	10,000	....
Newberg	....	9,350	....
Pennsylvania:			
Allentown	....	19,500	....
Ambler	2,535	375	....
Beaver	200	....	....
Bethlehem	....	27,199	511
Clearfield	747	76	....
Duquesne	1,000	....	....
Hamburg	....	510	....
McDonald	1,116	....	....
Mt. Union	300	400	....
Phoenixville	....	1,000	....
South Carolina:			
Easley	....	800	....
Texas:			
Ennis	1,000	....	....
Vermont:			
Brattleboro	1,600	2,000	....
Montpelier	1,900	....	....
Newport	....	1,900	....
Winooski	384	1,563	....
Virginia:			
Martinsville	2,900	9,060	....
Richmond	900	51,566	24
Washington:			
Aberdeen	3,000	10.000	....
Pullman	....	3,000	....
Washington (Continued)			
Seattle	....	132,559	21,580
Tacoma	6,096	115,508	16,788
Wisconsin:			
Beaver Dam	348	3,636	....
Clintonville	648	....	....
Edgerton	270	....	....
Fond du Lac	1,161	3,182	1,710
Fort Atkinson	381	3,049	....
Jefferson	....	3,768	....
Kaukauna	....	2,736	....
Kenosha	....	16,860	708
LaCrosse	200	7,739	1,320
Menasha	....	3,932	....
Milwaukee	....	227,906	29,528
Plymouth	183	....	....
Racine	..	65,926	1,129
Rhinelander	500	3,200	....
Stevens Point	58	8,574	....
Watertown	148	3,844	....
Waukesha	....	24,000	....
Wausau	102	12,706	....
Canada:			
British Columbia, Victoria	3,790	2,850	....
Manitoba:			
Winnipeg	....	20,179	154
New Brunswick			
Fredericton	....	2,760	....
Moncton	..	2,972	....
Woodstock	1,000	....	....
Ontario:	..		
Carleton Pl.	..	2,027	....
Dunnville	980	....	....
Guelph	3,000	1,500	....
Kitchener	459	10,329	2,400
Orilla	750	800	....
Oshawa	..	10,595	....
Peterborough	869	1,917	....
Stratford	300	....	....
Prince Edward Island:			
Charlottetown	980	....	....
Quebec:			
Levis	400	300	....
Montreal	....	87,607	20,600
Sherbrooke	....	2,937	727
Saskatchewan:			
Regina	205	29,780	1,856

a—Includes all sizes of c.-i. pipe.

Total Cast Iron Pipe in Use

City and State	Under 6-inch	6, 8, 10 and 12-inch	Over 12-inch
Alabama:			
Decatur	134,450	129,861	....
Arizona:			
Tucson	109,399	269,786	18,800
California:			
Burlingame	2 miles.	25 miles.	2 miles.
Lodi	2,000	40,000	....
Oxnard	49,768	26,439	800
Redlands	22,359	1,300	....
Sacramento	56,740	1,005,159	40,004
Colorado:			
Alamosa	....	12.5 miles.	5,000
Lamar	73,231	27,609	770
Montrose	....	13 miles*a*	....
Trinidad	78,470	110,486	22,413
Connecticut:			
Farmington	....	60,000	....
Hartford	39,730	1,262,242	298,314
Putnam	340	85,598	9,780
So. Manchester	136,000	88,000	10.000
Florida			
Plant City	11,900	72,810	....
St. Petersburg	55,785	727,322	11,609
Georgia:			
Newnan	30,000	42,000	....
Idaho:			
Burley	1,000	1,000	....
Caldwell	31,680	35,680	....
Preston	4,300	....	....
Illinois:			
Bloomington	54,673	268,891	102,000
Herrin	6 miles.	50 miles.	10 miles.
Hillsboro	2,000	3 miles.	....
Johnson City	56,910	30,678	....
Lincoln	36,491	99,512	....
Oak Park	136,485	408,032	11,997
Olney	58,200	33,800	....
Quincy	8,338	492,216	25,366
Rockford	161,432	782,502	71,983
Rock Island	....	100 miles.	3 miles.
Waukegan	5,330	446,640	17,690
West Chicago	9,030	70,896	....
Wheaton	20,000	301,100	....
Indiana:			
Brazil	67,413	13,410	4,350
Columbia City	35,013	28,379	....
Connersville	69,013	95,419	....
Delphi	28,900	2,000	....
Knightstown	22,000	8,300	....
Indiana (Continued)			
Logansport	....	63 miles.	....
Nappanee	28,637	4,494	....
New Albany	23,500	169,000	15,000
Peru	650	140,925	....
Richmond	18,113	315,093	35,419
Rushville	34,599	72,909	1,500
Sullivan	25,000	20,000	....
Whiting	....	64,630	6,415
Iowa:			
Burlington	42,258	329,249	14,012
Carroll	37,000	32,000	....
Council Bluffs	44.71 mi.	68.64 mi.	7.35 mi.
Creston	18,000	3,000	6,000
Dubuque	34,576	481,257	28,044
Mason City	5 miles.	61 miles	....
Oskaloosa	68,460	....	....
Red Oak	45,000	27,000	....
Sioux City	40,702	873,053	71,384
Washington	52,800	18,080	300
Kansas:			
Coffeyville	119,952	111,892	11,082
Hutchinson	15,200	240,000	....
Mulberry	6,500	2,000	....
Osage City	40,000	9,000	....
Kentucky:			
Hazard	5,000	54,000	
Louisville		2,357,118	641,809
Providence	3,000	17,500	....
Louisiana:			
Mansfield	25,000	56,075	....
Maine:			
Augusta	61,200	190,000	75,000
Van Buren	18,093	10,063	....
Maryland:			
Cumberland	62,000	38,000	34,000
Washington Suburban Sanitary District	128,753	997,404	91,097
Salisbury	22,800	91,950	2,500
Massachusetts:			
Belmont	8,938	282,611	
Brockton		631,208	129,443
Danvers	72,477	161,289	30,133
Dracut	3,000	9 miles.	....
Malden	26,617	427,043	20,009
Marlboro		44.17 miles.	3.55 miles.
New Bedford	8,832	840,719	201,131
No. Adams	....	272,459*b*	....
Oak Bluffs	21,934	97,595	....

City and State	Under 6-inch	6, 8, 10 and 12-inch	Over 12-inch
Massachusetts (Continued)			
Spencer	21,990	22,015	13,450
Springfield	62,991	1,111,092	198,069
Stoneham	19,887	146,013	....
Swampscott	113,686	142,861	3,721
Turners Falls	37,698	51,960	28,115
Waltham	....	83.35 miles*b*	....
Webster	....	149,850	....
Whitinsville	19,445	63,195	7,798
Williamstown	21,955	88,115	....
Winthrop	29,179	148,034	....
Worcester	67,294	1,054,113	409,301
Michigan:			
Coldwater	73,760	70,868	325
Dearborn	55,149	915,688	49,935
Detroit	644,028	11,878,226	1,450,000
Durand	....	9.8 miles.*c*	....
Gladstone	8,000	60,000	....
Midland	16,368	81,312	3,168
Mt. Clemens	....	211,200	....
Niles	76,283	83,042	11,748
Paw Paw	12,000	14,600	....
Petoskey	6 miles.	12 miles	2 miles.
So. Haven	44,390	55,241	4,974
Minnesota:			
Aurora	9,000	13,000	....
Cloquet	6,308	96,462	....
Duluth	13,048	1,050,930	106,666
Fairmont	52,000	32,000	6,000
Lake City	200	21,000	....
Minneapolis	....	3,675,000	556,000
Staples	4 miles.	1 mile.	....
Mississippi:			
Clarksdale	40,000	110,000	500
Jackson	21,900	410,000	57,600
Natchez	5.6 miles.	18.5 miles.	0.2 miles.
Missouri:			
Clinton	30,000	35,531	....
DeSoto	8 miles.	2 miles.	....
Jefferson City	3,827	130,680	....
Liberty	54,141	21,260	....
St. Louis	375,250	1,661,670	186,750
Trenton	56,000	87,700	....
Montana:			
Billings	38,430	182,567	22,386
Bozeman	25,600	97,000	18,800
Kalispell	4,213	78,700	5,860
Nebraska:			
Fremont	126,720	54,440	....
Lincoln	....	215.6 miles.	....
Plattsmouth	1,839	47,515	....
New Hampshire:			
Claremont	....	115,001*d*	....
Keene	63,772	20,706	8,674
Manchester	24,555	756,512	108,817
Newmarket	....	8 miles.	....
Newport	6,590	106,376	....
New Jersey:			
Belleville	....	262,878	730
Bridgeton	31,164	162,307	18,907
Merchantville and Pensauken	31,465	423,120	....
Glen Ridge	26,016	82,525	....
Hawthorne	2,500	....	....
Irvington	38,200	292,800	9,300
Madison	129,800	65,460	....
Milltown	2,900	41,581	....
Ridgewood	....	441,925	18,068
Woodbury	....	33-1/3 miles.	....
New Mexico:			
Deming	1,600	20,000	....
Raton	4 miles.	6 miles.	....
Tucumcari	45,400	16,900	....
New York:			
Binghamton	66,976	506,562	97,798
Dansville	15,400	70,300	....
Elmira	20,439	607,347	41,887
Greenport	4 miles	8 miles	....
Herkimer	44,030	78,130	....
Hudson	8 miles.	7 miles.	18 miles.
Lancaster	55,000	51,000	....
Little Falls	29,100	76,070	4,100
Mohawk	25,000	930	....
Mt. Vernon	21,722	452,225	18,962
Norwich	51,852	54,542	....
Saugerties	24,900	53,945	23,760
Syracuse	....	353.54 miles*e*	....
Utica	329,799	815,424	238,370
Waterford	20,910	40,467	....
North Carolina:			
High Point	50,000	390,000	21,500
Lexington	....	43.5 mi.	4 mi.
Rocky Mount	36,145	147,506	17,328
Wilmington	28,740	207,400	18,040
Winston-Salem	66,000	762,505	100,325
North Dakota:			
Fargo	20,083	308,995	18,223
Grand Forks	4,940	139,833	9,628
Ohio:			
Akron	290,140	2,281,000	258,400
Barnesville	4,500	15 mi.	....
Conneaut	23,703	117,306	2,189
Defiance	10,000	113,000	7,000
East Cleveland	13,677	274,307	30,665
Elyria	26.0 mi	40.7 mi.	11.4 mi.
Gibsonburg	31,600	11,480	....
Huron	14,444	24,491	....
Kent	18,500	92,380	....
Lancaster	79,898	102,904	4,225
Lima	....	125 *b*	....
Mingo Junction	3.06 mi.	5.12 mi.	....
Newark	....	89.25 mi. *f*	....
Orrville	30,390	54,140	....
Sylvania	30,000	10,000	....
Warren	428,228	120,224	7,254
Wellsville	38,000	22,500	7,400
Wilmington	50,000	30,000	....
Youngstown	40,763	1,721,737	77,430
Oklahoma:			
Drumright	4 mi.	8 mi.	....
Mangum	14 mi.	2 mi.	....
Newkirk	38,100	33,000	....
Oregon:			
Marshfield and North Bend	151,536	114,371	....
Newberg	2,000	13,000	....
Pennsylvania:			
Allentown	96,832	608,509	7,332
Beaver	12 mi.	3 mi.	....
Bethlehem	....	110.7 mi. *d*	....
Catasauqua	6,400	24,239	1,824
Clearfield	79,303	61,336	525
Danville	2 mi.	2 mi.	....
Duquesne	52,500	57,750	....
Ellwood City	....	39.5 mi. *g*	....
Emporium	19,760	65,500	....
Ford City	20,650	25,500	7,550
Hamburg	....	51,479*a*	....
Huntingdon	2,000	....	....
McDonald	28,454	47,814	....
Mt. Union	8 mi.	12 mi.	....
Phoenixville	16,000	88,000	1,300
Wellsboro	30,254	30,611	....
So. Carolina:			
Darlington	4,083	47,875	....
Easley	1,000	56,000	....
Vermont:			
Brattleboro	47,340	46,950	32,420
Montpelier	....	141,450*b*	....
Winooski	21,120	32,894	....
Virginia:			
Lexington	43,550	6,750	....
Martinsville	39,000	1,800	....
Richmond	321,545	1,400,894	99,923
Washington:			
Aberdeen	15 mi.	35 mi.	3 mi.
Dayton	....	18,200	....
Pullman	....	9,300	....
Seattle	....	3,245,418	418,146
Tacoma	94,936	836,886	128,554
West Virginia:			
Weston	56,000	16,000	....
Wisconsin:			
Beaver Dam	25,061	10,816	....
Clintonville	....	53,848*b*	....
Edgerton	24,382	22,713	....
Fond du Lac	60,507	235,091	11,437
Fort Atkinson	51,545	42,626	....
Jefferson	38,873	22,910	....
Kaukauna	10,067	78,929	120
Kenosha	34,569	517,648	40,009
LaCrosse	1,500	394,033	41,362
Menasha	16,214	108,482	....
Milwaukee	40,686	4,032,156	472,735
Plymouth	46,820	16,832	....
Racine	701,185	24,176	....
Rhinelander	26,500	96,950	200
Two Rivers	33,981	83,145	....
Watertown	29,616	141,020	3,423
Waukesha	3,400	310,000	12,000
Wausau	42,694	205,346	....
Canada:			
British Columbia:			
Penticton	70,000	12,000	....
Manitoba:			
Winnipeg	65,392	1,424,064	111,924
New Brunswick:			
Fredericton	14,100	70,400	....
Moncton	33,819	135,512	46,319
Woodstock	25,000	18,000	1,000
Ontario:			
Carleton Pl.	....	17,066	....
Dunnville	29,000	8,000	....
Guelph	111,000	119,394	3,150
Kitchener	76,069	218,777	3,688
Orilla	48,760	59,800	2,700
Oshawa	81,887	160,643	9,960
Owen Sound	2,000	45 mi.	1,200
Peterborough	136,651	110,713	21,592
Stratford	32,891	174,025	....
Prince Edward Island:			
Charlottetown	19,676	89,275	15,768
Quebec:			
Levis	23,063	51,023	700
Montreal	....	413,615	3,998,000
St. Lambert	7,379	116,876	....
Sherbrooke	33,186	128,673	55,611
Saskatchewan:			
Regina	925	68.1 mi.	6.0 mi.

a—Include 4 in. pipe. *b*—Includes all sizes. *c*—Includes 4 in. to 10 in. pipe. *d*—Includes over 12 in. diameter. *e*—Includes 6 in. to 48 in. pipe. *f*—Includes 3 in. to 16 in. pipe. *g*—Includes 4 in. to 16 in. pipe.

(Continued on page 54)

Two

5 TRACTOR SIZES TO MEET ANY POWER NEED

CLETRAC 20	$1575
CLETRAC 30	2475
CLETRAC 40	3685
CLETRAC 80-60	5250
CLETRAC 100	7500

All Prices F. O. B. Factory

For latest catalogs—consult the *classified* INDUSTRIAL LITERATURE section, beginning on page 119

Thousand Hours of Heavy Work

-and no time lost for repairs

TWELVE months ago Platte County, Mo., added a Cletrac to the county's equipment. It was a Cletrac "40" —famous for power and dependability. One of its first jobs was grading and dragging 120 miles of roadway. Within one year's time this rugged Cletrac rolled up a total of 2000 working hours—and no time lost for repairs!

Such performance is typical of Cletracs. Inbuilt stamina is one of their strongest characteristics. They have proved their ability to stay on the job day after day and month after month—to keep going without loss of time for adjustments or repairs. That is the kind of service Cletracs are giving to thousands of satisfied users.

Whatever the class of work there is a Cletrac size and model to handle it—better and at lower cost! Five units to choose from, with a power range from 20 to 100 h. p. See the Cletrac distributor near you or write direct to us for literature.

Cletrac
Crawler Tractors

THE CLEVELAND TRACTOR CO.
19322 Euclid Avenue CLEVELAND, OHIO

For latest catalogs—consult the *classified* INDUSTRIAL LITERATURE section, beginning on page 119

Steel Mains*

City and State	Under 12" diam. Laid in 1929	Under 12" diam. Total in use	12" diam. and Over Laid in 1929	12" diam. and Over Total in use
Arizona:				
Tucson	9,859	145,914	....	....
California:				
Redlands	....	89,347	....	248,530
Sacramento	....	....	....	85,468
Colorado:				
Alamosa	3,000	16 mi.	....	....
Montrose	....	14 mi.	....	....
Trinidad	1,536	65,221	....	151,031
Delaware:				
Wilmington	....	....	430	....
Idaho:				
Caldwell	....	10,560	....	....
Indiana:				
New Albany	....	30,000	....	....
Sullivan	....	5,000	....	....
Kansas:				
Coffeyville	....	20,000	....	....
Kansas City	....	....	1,200	....
Mulberry	....	....	....	9,350
Maryland:				
Washington Suburban Sani. Dist.	....	35,916	....	....
Massachusetts:				
Boston	....	....	7,850	....
New Bedford	....	....	....	42,381
Springfield	....	....	38,630	107,244
Worcester	13,415	455,781	....	....
Michigan:				
Detroit	....	....	62,550	205,000
Midland	....	500	....	....
Monroe	....	....	5,400	....
Petoskey	....	1 mi.	....	....
Royal Oak	....	....	12,500	....
Minnesota:				
Duluth	....	718	....	32,781
Minneapolis	....	....	15,500	24,000
Missouri:				
Clinton	....	2,000	....	....
Montana:				
Bozeman	....	100	....	12,800
Kalispel	....	19,706	....	....
Ronan	....	4 mi.	....	....
New Jersey:				
Kearny	....	....	1,460	....
Newark	....	....	25,400	....
Wanaque	....	....	174,800	....
New Mexico:				
Deming	....	25,000	....	....
Raton	....	....	....	2 mi.
New York:				
New York City	....	....	35,730	....
Utica	....	....	....	1,287
Ohio:				
Akron	....	....	....	121,000
Cleveland	....	....	26,400	....
Defiance	....	6,500	....	....
Elyria	....	....	....	4.5 mi.
Huron	....	4,898	....	....
Youngstown	....	....	81,800	....
Oregon:				
Bend	....	98,251	....	4,934
Corvallis	....	....	18,000	....
Newberg	....	10 mi.	....	....
Pennsylvania:				
Erie	....	....	8,000	....
Pittsburgh	....	....	1,100	....
Philadelphia	....	....	1,200	....
Washington:				
Aberdeen	2,000	2 mi.	....	4 mi.
Dayton	1,000	59,150	....	....
Seattle	448	4,348	114	57,473
Tacoma	....	....	....	53,035
Canada:				
Ontario:				
Carleton Place	....	27,177	....	2,805
Quebec:				
Montreal	....	....	....	61,900

Wrought Iron Pipe*

City and State	Laid in 1929 Size	Laid in 1929 Length	Total in Use Size	Total in Use Length
Lodi, Calif.	2"	1,000	2"	15,000
Oxnard, Calif.	....	....	3"	2,270
Redlands, Calif.	1½" to 4"	4,721	1" to 12"	496,779
Alamosa, Colo.	....	....	¾"	15,000
So. Manchester, Conn.	....	....	1¼"—2"	6,700
St. Petersburg, Fla.	....	4,368	....	665,798
Twin Falls, Ida.	....	....	4" to 24"	....
Hillsboro, Ill.	....	....	3"	400
Lincoln, Ill.	....	....	¾" to 2"	43,753
Mt. Olive, Ill.	....	....	4"	2,000
Quincy, Ill.	....	....	2" & less	10,295
New Albany, Ind.	....	....	¾" to 2"	38,000
Carroll, Ia.	....	....	2"	10,000
Washington, Ia.	....	....	1" to 2"	5,000
Columbus, Kans.	....	500	....	....
Rayne, La.	¾" to 2"	15,000	....	....
Van Buren, Me.	....	....	¾" to 2"	10,101
Salisbury, Md.	¾" to 2"	6,500	¾" to 2"	29,000
Dracut, Mass.	....	....	2"	6 mi.
Framingham, Mass.	2"	781	....	....
Webster, Mass.	....	....	1" to 3"	11 mi.
Winthrop, Mass.	....	....	1½" to 2"	5,164
Worcester, Mass.	....	....	1"	5,056
Jackson, Miss.	¾" to 2"	12,000	....	....
Natchez, Miss.	....	....	4"	0.3 mi.
De Soto, Mo.	....	....	¾" to 2"	2 mi.
Jefferson City, Mo.	¾" to 2"	1,000	¾" to 2"	46,815
Liberty, Mo.	1½"	500	....	....
Plattsmouth, Neb.	....	....	2" & less	44,956
Bridgeton, N. J.	....	....	....	1,550
Irvington, N. J.	....	....	....	6,700
Tucumcari, N. M.	....	....	1" & 2"	11,000
Dansville, N. Y.	....	....	1¼" & 2"	1,800
Elmira, N. Y.	....	1,920	....	74,273
Waterford, N. Y.	....	....	....	1,166
Winston-Salem, N. C.	....	....	1" to 2"	120,000
Conneaut, O.	1" to 3"	1,252	1" to 3"	17,089
Mingo Junction, O.	2" & 3"	3,773	¾" to 3"	19,000
Orrville, O.	....	1,940	....	4,610
Wellsville, O.	....	....	2"	500
Bend, Ore.	....	....	2" to 14"	97,325
Newberg, Ore.	¾" to 2"	400	¾" to 2"	10 mi.
Clearfield, Pa.	....	112	....	7,230
Darlington, S. C.	....	....	1" to 1½"	4,440
Montpelier, Vt.	1" to 2"	601	1" to 2"	30,510
Newport, Vt.	1"	300	....	....
Martinsville, Va.	1"	20,000	1"	20,000
Aberdeen, Wash.	1½" to 2"	10,000	1½" to 2"	16 mi.
Pullman, Wash.	....	....	4"	5,000
Seattle, Wash. *a*	2" to 4"	32,482	2" to 4"	596,287
Tacoma, Wash.	2" to 6"	920	2" to 6"	175,380

*Some pipe reported as wrought iron may be steel; and some of them may include services although "street mains" only were asked for.
a—Some of these are steel.

Other Kinds of Pipe

City and State	Laid in 1929 Size	Laid in 1929 Length	Total in Use Size	Total in Use Length
Wood				
Trinidad, Colo.	....	....	20", 24", 30"	52,616
So. Manchester, Conn.	....	....	18"	23,000
Burley, Ida.	....	....	4" to 10"	7 mi.
Caldwell, Ida.	....	....	4"	18,000
Delphi, Ind.	....	....	6"	3 Mi.
Sullivan, Ind.	....	....	12"	40,000
Wash. Sub. San. Dist.	....	....	4", 6", 8"	38,525
Billings, Mont.	....	....	6" to 24"	18,045
Kalispell, Mont.	....	....	6" to 18"	18,376
Utica, N. Y.	....	....	12" to 24"	727
Winston-Salem, N. C.	....	....	30" to 36"	20,000
Newberg, Ore.	....	....	10"	2.5 Mi.
Aberdeen, Wash.	....	....	4" to 28"	31 Mi.
Pullman, Wash.	....	....	6"	1,000
Snohomish, Wash.	4" & 6"	8,000	....	....
Tacoma, Wash.	....	....	2" to 24"	445,000
Concrete				
Hartford, Conn.	42"	5,300	42"	5,300
			30"	15,581
			48"	4,646
Cumberland, Md.	....	....	36"	45,000
Claremont, N. H.	....	....	4" to 24"	94,681
Cement Lined				
Spencer, Mass.	....	....	4" to 12"	27,194
Springfield, Mass.	....	....	24"	31,737
Winthrop, Mass.	....	....	2" to 4"	3,496
Cement Lined Sheet Iron				
Hoosic Falls, N. Y.	....	....	....	4,000
Kalamein				
Duluth, Minn.	....	....	4" to 12"	4,596
Billings, Mont.	....	....	8"	2,056
Vitrified Pipe				
Hartford, Conn.	....	....	....	16,700
Utica, N. Y.	....	....	4" to 24"	21,758
Galvanized Iron				
Orlando, Fla.	2" & under	16,000	....	....
Johnston City, Ill.	....	....	2"	1,000
Whiting, Ind.	....	....	2" & 3"	3,250
Oak Bluffs, Mass.	....	....	¾" to 2"	17,604
Duluth, Minn.	....	....	2"	345
St. Louis, Mo.	....	....	1" to 3"	855,730
Lancaster, O.	....	....	....	8,608
Dayton, Wash.	2"	600	2"	12,910
Fond du Lac, Wis.	1"	218	1" & 2"	25,722
Kenosha, Wis.	....	....	1" to 2"	18,479
Oshawa, Ont., Can.	....	....	1" to 2"	4,873

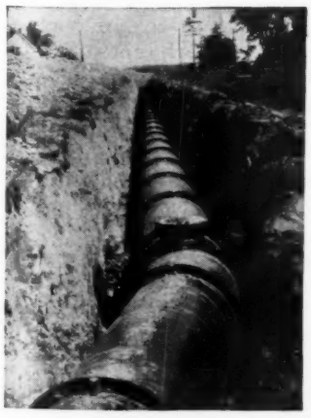
At ALBANY—the world's largest cast iron water main installation is nearing completion

Fairchild Aerial Surveys, Inc.

THE CITY OF ALBANY, NEW YORK, is building a remarkable new water supply system. The main supply line consists of a conduit 48 inches in diameter and 20 miles long—built entirely of cast iron pipe. Large diameter cast iron pipe was specified for this giant project because of its known record of durability. Cast iron pipe lasts for centuries and there is a definite reason for its long life. Water and gas mains of ferrous metal (iron and steel) with the exception of cast iron disintegrate from rust. Cast iron pipe is the only ferrous metal pipe practicable for underground mains which rust will not destroy.

The efficiency and economy of large diameter cast iron mains has always been recognized by engineers and city officials—never more so than today. Last year more large diameter cast iron pipe was produced than in any previous year and the production curve is constantly rising.

If you, Mr. Engineer, or you, Mr. City Official, are in any doubt regarding the kind of pipe to put down for any water, gas or sewer job, we shall appreciate an opportunity to place all the facts and figures before you. Address The Cast Iron Pipe Research Association, Thomas F. Wolfe, Research Engineer, 309 People's Gas Building, Chicago. Cast iron pipe bearing the "Q-check" trade mark is obtainable from the following leading pipe founders: Alabama Pipe Company, Anniston, Ala; American Cast Iron Pipe Company, Birmingham, Ala.; James B. Clow & Sons, 219 N. Talman Avenue, Chicago, Ill.; Donaldson Iron Company, Emaus, Pa.; Glamorgan Pipe and Foundry Company, Lynchburg, Va.; Lynchburg Foundry Company, Lynchburg, Va.; National Cast Iron Pipe Company, Birmingham, Ala.; United States Pipe and Foundry Company, Burlington, N. J.; Warren Foundry and Pipe Company, 11 Broadway, New York.



A typical section of Albany's great cast iron supply line.

CAST Q IRON

The "Q-check" symbol shown above has been adopted as the trade mark of The Cast Iron Pipe Research Association.

CAST IRON PIPE

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Acquisition, Maintenance and Operation of Airports by Municipalities

Decisions by the state courts as to power of municipalities to incur indebtedness for such purposes. Airports included as a public purpose.

By John Simpson

WITHIN the past three years important decisions have been handed down by various state courts regarding the acquisition of land for airports or landing fields for aircraft, and the establishment, maintenance and operation of them by municipalities, either within or without the municipal limits. The proceedings have usually been instituted to challenge the validity of bond issues on the ground of lack of statutory authority in the municipality to incur indebtedness for such a purpose.

The Air Commerce Act of 1926 provided that civil airports should not be owned or operated by the federal government, thus leaving that field for the municipalities or for private enterprise. The authority of the municipalities in the matter must rest on state statutes or city charters. So far the statutes under which such authority has been claimed have been held constitutional where their constitutionality has been challenged; and their provisions have been held broad enough to cover the establishment and operation of municipal airports. In these cases a municipal airport has been held to be a "public purpose," a "public utility," a "city purpose" or "municipal purpose," and to be embraced within a provision for "park purposes." And in various cases the courts have emphasized the expedience and importance of the establishment of airports by municipalities.

The various decisions are set forth here in their chronological order.

Power to Issue Bonds

In a proceeding against the city of Cleveland, Ohio, it was claimed that the Ohio Constitution does not permit the city of Cleveland to issue bonds for the purpose of paying for land acquired or to be acquired by it, outside of the limits of the city, for a landing field for aircraft, and for improving the land so acquired.

The ordinance providing for the issue was passed as an emergency ordinance in the manner required by the city charter, and its emergency character was therein declared and set forth by the council. There was shown no challenge thereof by any proceeding to institute a referendum or otherwise until the bringing of this suit, which was subsequent to the time allowed for instituting a referendum. Therefore the court considered the ordinance effective immediately upon its passage, and refused to inquire into its emergency character, determined by the council. State ex. rel. Hile v. City of Cleveland, 26 Ohio Court of Appeals, 265, 160 N. E. 241 (1927).

On the question of the authority of the city to pass the ordinance, the court quoted section 3, article XVIII of the State Constitution, to the effect that all municipalities of the state have authority to exercise all powers of local self-government, and section 4 of said article, under which any municipality may acquire, construct, own, lease, and operate, within or without its limits, any public utility the products or services of which are, or are to be, supplied to the municipality or its inhabitants.

If there is any doubt, the court said, as to the authority of the city, by these constitutional provisions, to acquire, own and operate an air landing field, as contemplated by the ordinance under consideration, then all doubt must be removed by paragraph 15 of section 3677, Ohio General Code, and paragraph 29 of section 3939 of that Code, in which paragraphs express authority is conferred upon the municipalities of the state to do the things contemplated by the ordinance, "which authority to confer such power the Legislature no doubt has, unless prohibited by some provision of the Constitution, which prohibition we are unable to find."

Section 3677, par. 15 gives municipalities power to appropriate real estate for establishing landing fields, either within or without the limits of a municipality, for air craft and transportation terminals and for rights of way for highways and railroads to connect same with main highways or railroad lines, all of which are thereby declared to be public purposes. Section 3939, par. 29, authorizes the issue of bonds for such purposes, and for equipping the property with structures necessary or appropriate therefor.

Airport a Park Purpose

The question in the case of City of Wichita v. Clapp (January 7, 1928) 125 Kan. 100, 263 Pac. 12, was whether a city having by statute power to acquire, by purchase, gift, condemnation or otherwise, land deemed necessary for public parks outside of the corporate limits of the city and within five miles thereof (Kansas Laws of 1927, ch. 117) could acquire such property under the statute where 70 per cent of the ground was to be devoted to the maintenance of an airport or landing field. In other words whether park purposes may include an airport or landing place for airplanes.

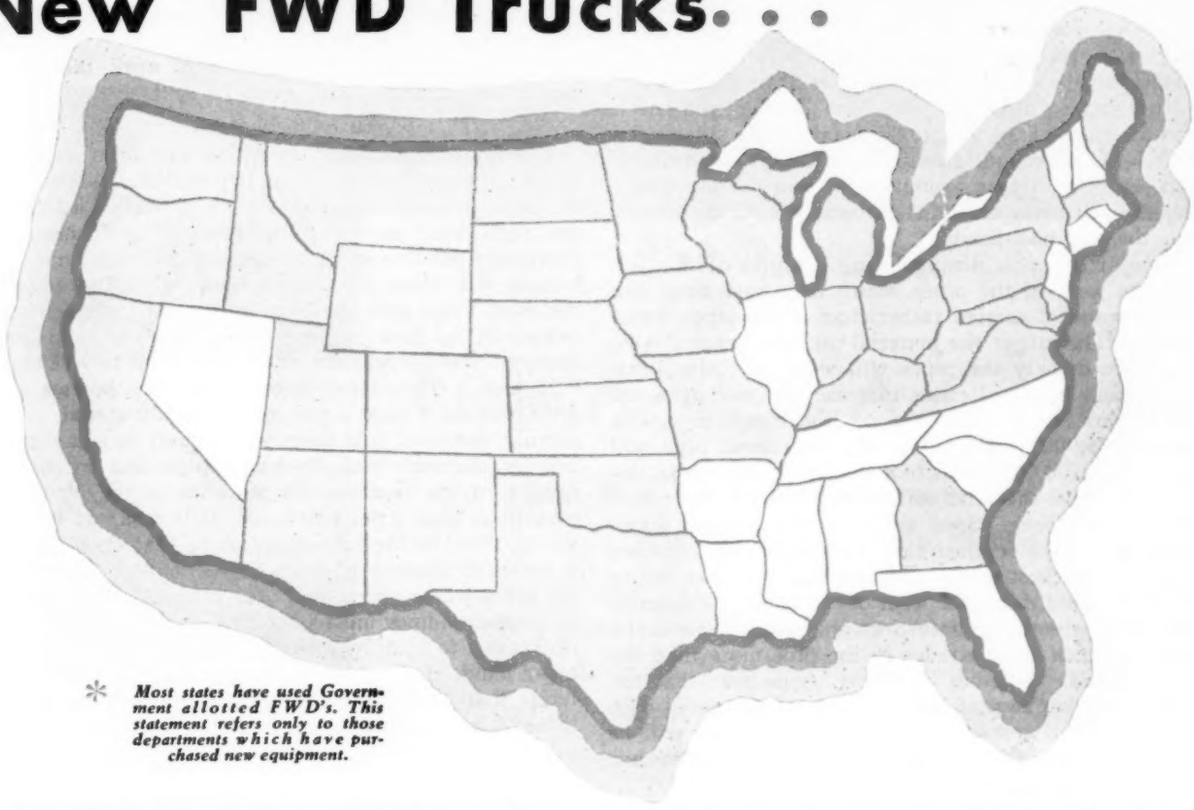
"Under various authorities," the court said, "the expression 'park purposes' has been held to include a race track, bridle trails, boating, bathing, refreshment and lunch stands, providing bathing suits, towels and rooms for bathers, dressing pavilion, waiting room for street cars, refreshment and shelter room for the public, grandstand, ball games, baseball diamond, race meets, tennis courts, croquet grounds, children's playgrounds, hotels, restaurants, museums, art galleries, zoological and botanical gardens, conservatories, and many other recreational and educational facilities."

After reviewing several of these decisions the court emphasized the desirability of the possession of airports by municipalities as follows:

"The last few years have witnessed a remarkable development of aviation in all lines. In a pamphlet on airport construction, issued by the aeronautics branch of the United States Department of Commerce, it is said: 'The commercial value of an airport is not its only consideration. It has an important value

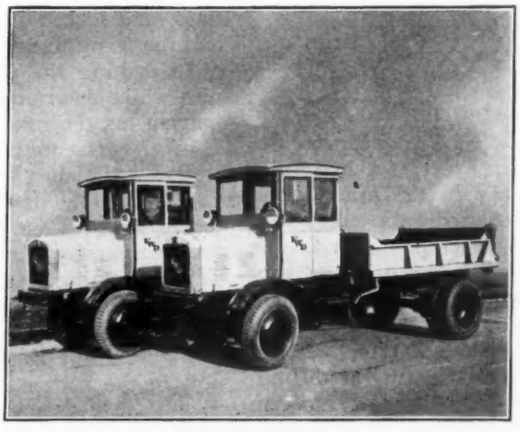
(Continued on page 84)

33 State Highway Departments Have Purchased New * FWD Trucks. . .



* *Most states have used Government allotted FWD's. This statement refers only to those departments which have purchased new equipment.*

THIRTY-THREE state highway departments and five Canadian provincial highway departments have purchased FWD trucks. These trucks are used for general hauling, and such "extra work" as snow removal and pulling graders, scrapers and drags. The 1930 FWD is modern in every respect. Twenty years of continual improvement has resulted in a truck which meets the present demand of progressive truck operators. Power, speed, traction—they are all embodied in this good-looking, four-wheel drive truck. Write for literature today.



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Hydraulic Fill Construction at Cobble Mountain Dam

(*Continued from page 21*)

mines the limit of the core and should be maintained at the predetermined distance from the center line for each elevation. This is being done; if the core pool pump is for any reason unable to keep the pool down to the required elevation, the sluicing is interrupted until it catches up. Thus our beach is always very stable and the core satisfies the specifications.

In order to insure a good bond between the beach and the sides of the gorge, the ledge on the side slopes within the maximum core limits is always cleaned and exposed, the stripping monitor in the core pool sluicing the soil cover on the slopes and delivering it outside the core pool limits.

One of the most disappointing features of this job was the wear of the pipes, which may have been due to the material carried rather than to the pipes themselves. The larger the material and the heavier it is, the more quickly the pipes will wear out; also steep slopes and high velocities increase the rate of wear. We almost wore out our mud line completely with about 125,000 yards. The life of a mud pipe will vary from 100,000 yards to about 2,000,000 yards, depending upon the kind of material and the other factors named above. Sand and clay will result in maximum life. We learned that the bends and breeches were the quickest to go, and that heavy rubber lining in them would delay the wear of the metal. Evidently the shock-absorbing nature of the rubber can resist the impact of the particles in the pipe more than the metal itself. Another discovery made was that the higher the per cent of load carried (as compared with the amount of transporting water) the longer will be the life of the pipe. However, there is a limit to this, say, perhaps 25 per cent load by weight.

The pipes do not all fail at the same time, neither do they have a uniform wear and tear. Local defects in the metal and also in the joints will give away first. Those places are immediately repaired in the field. The bottom of a pipe line wears out the quickest, and the pipes are turned one-quarter of a revolution as the necessity requires, until there has been a complete wear of the entire shell of the pipe.

The Plant

Winston & Co., of Kingston, N. Y., which has the contract for the dam, used last year, for hydraulic operations, three pumps floating in the intake pool, which supply the water for the hydraulic nozzles; a pump floating in the core pool, which pumps from this into the intake pool; all electrically operated, and supported by pontoons. The main water line is 4,000 feet long, 28 in. diameter; line to the "giants," 3,000 feet, 18 in. diameter; mud line, 5,500 feet, 20 in. diameter. There are six hydraulic giants at the pit, and a stripping monitor mounted on a small float in the core pool. Four transformers reduce the power line voltage to 2,200 for the pumps.

For various reasons we had a very short working season in 1929, and only 125,000 yards were placed. This was enough, however, to show that additional equipment would be necessary for finishing the work in 1930, and the contractor added 1,000 feet of 28 in. pipe, 6,000 feet of 20 in. pipe, 3,000 feet of 18 in. pipe and two 14,000 g.p.m. pumps. Details of this plant are given at the end of the article, with itemized costs. The total cost has been $160,000.

We have a total of 1,330,000 yards to be placed, and the cost of plant therefore averages a little over 12 cents per yard. The power consumption is 7½ k.w.h. per yard and the price is 1.6 cents per k.w.h.; giving a power cost of about 12 cents per yard. The labor will not cost more than about 12 cents per yard. This gives the total cost to the contractor of about 36 cents per yard. The contract price is 50 cents, apparently leaving 14 cents per yard, or 28 per cent of the unit price, to cover all overhead and profit. This was the lowest of eight bids for this job received from contractors accustomed to this class of work, the average of all of which was about 70 cents.

Note on Borrow Pits

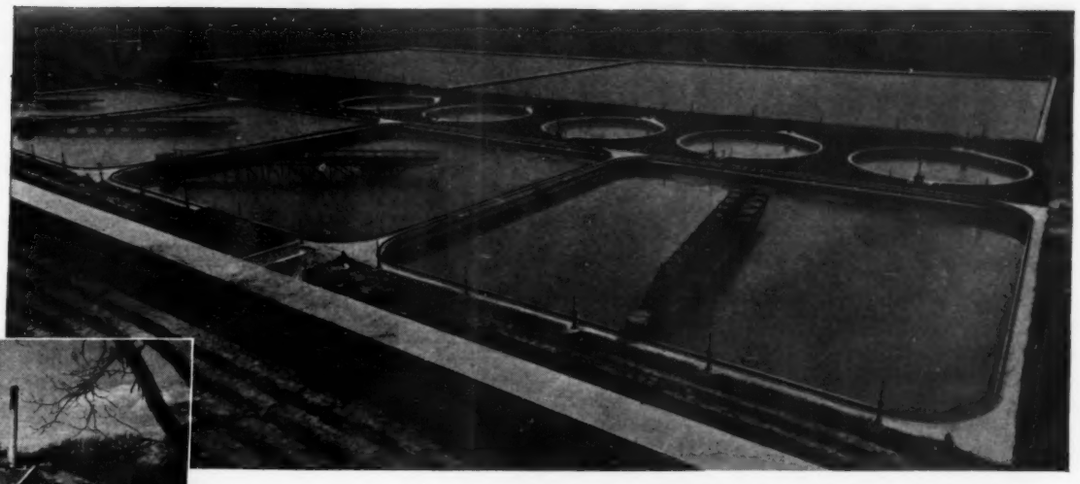
The quality, quantity, elevation and location of a borrow pit are each of great importance. Above all, the deposit should contain suitable material, not only the right kind in regard to physical and chemical properties but also in its gradation. Perhaps an illustration will show the requirements of a borrow pit material. Our core is about 20 per cent of the total volume of the dam exclusive of the rock toes, and it is required that 10 per cent of the core must be less than 0.01 mm. Therefore, theoretically the borrow pit must contain at least 2 per cent of such material. Assuming, however, that there will be half as many fines lost by the core pool discharge pipe and by being caught in the beaches, our material in the pit must contain at least 3 per cent under 0.01 mm. If the investigations in the laboratory show that there is not a sufficient number of fines, it will mean that either the pit must be abandoned or a proportionate amount of necessary fines must be added during the sluicing operations to comply with the specifications. On the other hand, if the borrow pit contains more fine material than required (for instance instead of having three it has six per cent), it will mean that some 10 per cent of the total volume of the borrow will have to be wasted.

Waste of this excess of fines involves great expense and sometimes is not easy. Very seldom is it found that a pit will entirely satisfy the particular requirements of a core. We had the case in both extremes. We had borrow pits which did not contain enough fines, and looked further around and found pits that had too many fines.

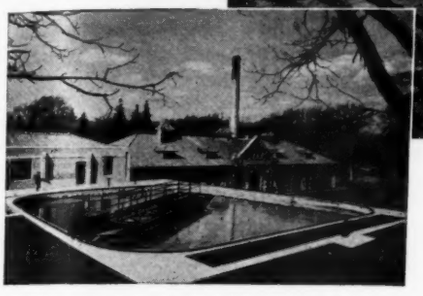
In making the preliminary studies on the borrow pits while determining the per cent of fineness and getting out the gradation curve, one must take care to have a representative sample of the pit; and the gradation curve must show the material that will be carried over to the dam, and should not include the large stones screened out by the grizzly.

The quantity of the deposit must be more than sufficient to build the dam. In estimating a deposit, the top few feet, depending on the conditions of the borrow area, should be neglected. There is always waste, and there will be considerable boulders and cobbles left in the bottom of the pit, although the shoulders should have as many as possible of these cobbles to make them drain and solidify more rapidly.

It is desirable to have the face of a borrow pit just as high as possible, provided the bottom of the pit will be left on the required grade. Clearing and grubbing expense will be the same over an area, no matter what the depth of borrow material; and again if you are in a shallow borrow pit you will be spreading out with your pit lines and monitors all over the area. In shallow borrow pits, often the surface of the ledge does not lie parallel to that of the ground, and projecting rocks here and there will always cause trouble, hindering the flow of excavated material to



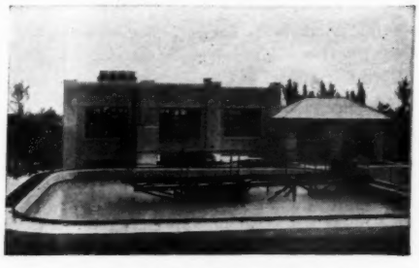
Four Dorr Traction Clarifiers in the Howard Bend Plant, St. Louis.
L. A. Day, Water Commissioner, E. E. Easterday, Designing Engineer



Mamaroneck, N. Y., Alexander Potter, Cons. Engr.

At the A. W. W. A. Convention—

You Will See Dorr Clarifiers in St. Louis' New Water Treatment Plant



Boca Raton, Fla., H. S. R. McCurdy, Cons. Engr.

IF you are planning on attending the convention of the American Water Works Association in St. Louis, you will undoubtedly see the Dorr Traction Clarifiers, which are used for primary and secondary sedimentation, in the Howard Bend water treatment plant.

However, it is not necessary to go to St. Louis to see these continuously cleaned sedimentation basins. Visit any recently built or currently building water treatment plant in the U. S. or Canada and you are almost sure to find Dorr Clarifiers on the job. The small illustrations show some of these installations.

Miami, Fla., Alvord, Burdick & Howson, Cons. Engrs.

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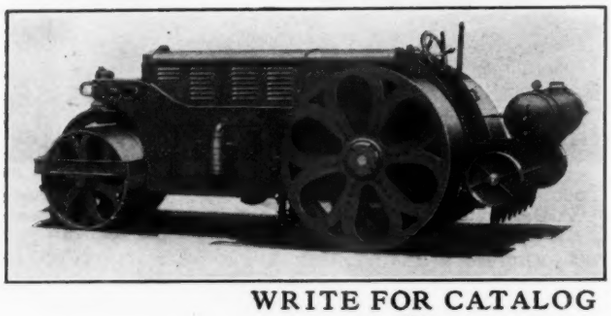
5 TO 15 TONS



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The F. D. Cummer & Son Co.

CLEVELAND, OHIO

the head box. On the other hand, with a deep borrow pit it is possible to excavate just to the required line of grade, perhaps even without going down to the bottom of the desposits.

The nearer the location of borrow pit to the dam, the better it is. Excess height for the pit is not essential. One that will give say 5 to 6 per cent grade to the mud line will be sufficient. If the height of the pit is such that gravity flow will be impossible, booster pumps will be required to force the material through the pipes.

The work is being done by the Board of Water Commissioners of the City of Springfield, of which E. E. Lochridge is chief engineer. Hazen and Everett of New York, are consulting engineers, and the writer is division engineer in charge of the work.

Details and Cost of the Plant

Supply Pumps:—Allis-Chalmers, Type 8F, size 20 in. x 18 in., 900 r.p.m., 16,000 g.p.m. against a head of 150 feet or 14,000 g.p.m. against a head of 160 feet. Synchronous motor, 675 h.p., 504 k.w., power factor 100, 2200 volts, 138 amps.

Three at $6,529.80 ..... $19,589.40
Two at $6,743 ..... 13,486.00

Core Pool Pump:—Allis-Chalmers, Type L.S., size 20 in. x 20 in., 720 r.pm., 16,000 g.p.m. against head of 60 feet or 14,000 g.p.m. against a head of 70 feet. Synchronous motor, 260 h.p., 194 k.w., power factor 100, 2200 volts, 54.6 amps.

One $4,985.00

The total plant efficiency is 84%.

Two vacuum pump primers 548.00
Miscellaneous tools for pumps 219.99

Pontoons:—For supply pumps: Five water-tight drums about ¼ in. thick, 48 in. diam., 26 ft. long, supporting supply pool pumps and 12 ft. x 24 ft. x 12 ft. house. Total weight pontoons, 10 tons; net flotation capacity, 40 tons.

Supply pool pontoons $1,755.99
Supply pool pump house 1,073.27
Miscellaneous tools and landing 1,033.92

For core pump: Four water-tight drums about ¼ in. thick, 48 in. diam., 26 ft. long, support core pool pump and 16 ft. x 18 ft. x 12 ft. house. Total weight pontoons, 8 tons; net flotation capacity, 32 tons.

Pontoons $1,506.55
Pump house, miscellaneous tools and landing 1,275.87

The pontoons were of boiler plates and made with welded joints at Walsh's Boiler Works, Holyoke, Mass.

Pipes:—Main water line, made of boiler plates (blue annealed); 1,000 ft. of 28 in. diam., ¼ in. thick, 30 ft. lengths, with Dressler couplings, @ $4.13 ..... $4,130.00
4,000 ft. of 28 in. No. 10 gauge (9/64 in. thick).
@ $3.18 ..... 12,720.00
Specials 3,985.64

Mud line, made of "Red hard" steel; 11,500 ft. of 20 in. diam., No. 9 gauge (5/32 in. thick), 20 ft. lengths, with slip joints, @ 3.30 ..... $37,950.00
Specials 1,717.95

Line to giants, made of "Red hard" steel; 6,000 ft. of 18 in. diam., No. 10 gauge (9/64 in. thick), 20 ft. lengths, with slip joints, @ $3.00 ..... $18,000.00
Specials 3,276.08

Giants:—Abendroth & Root No. 5 hydraulic giants with 5 in. and 6 in. interchangeable tips. These giants are about 6 ft. long and weigh one ton. They are designed for 100 to 400 lbs. nozzle pressure; the working pressure is 60 to about 100 lbs. for 12,000 to 16,000 g.p.m. 6 ..... $3,590.27

Stripping Monitor:—Mounted on a small float on the core pool. Operated with a 6 in. Cameron pump. 2 in. tip on the monitor; effective range of stream, about 70 ft.

Transformers:—General electric, Type O.C., capacity 1,000 k.v.a., voltage 22,000 to 13,000, to 2,200 volts; 4 transformers $5,149.50
Sundry electrical supplies and tools 10,735.38

Miscellaneous structures:—Foundation and housing for No. 2 and No. 3 supply (booster) pumps $331.57
Trestles and bracket lines 1,651.62
Flumes and grizzlies 876.33
Spillways 1,358.35
Pipe specials and miscellaneous 9,053.32

Total to date $160,000.00

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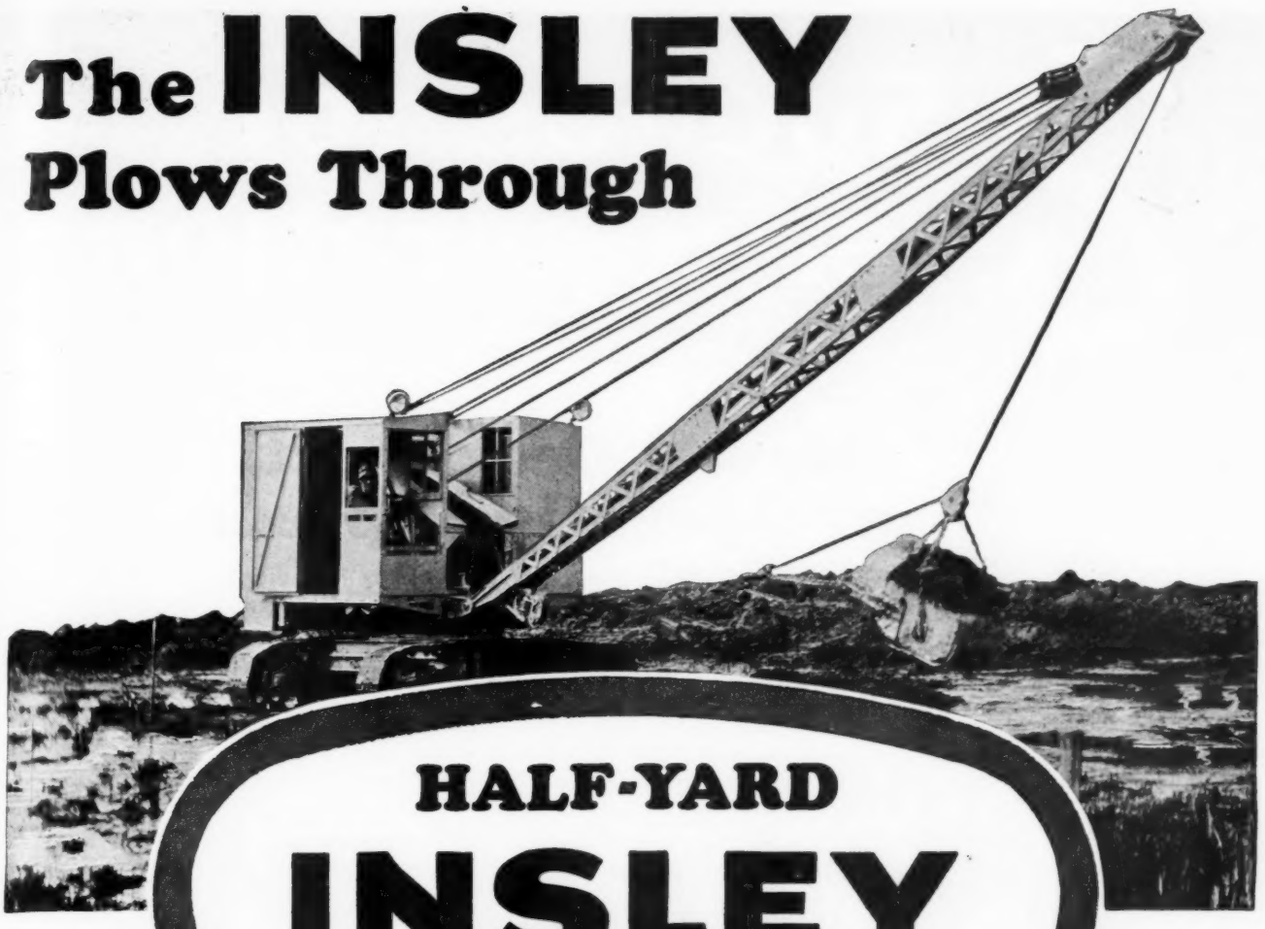

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When it has to go through soft, soupy soil or work among boulders and stumpage, easy steering — with the low square inch ground pressure of Insley multiplanes and the 20 inch ground clearance — takes the Half-Yard Insley anywhere.

—and once on the job as a shovel, crane, dragline or hoe it's a performing wonder, not only in yardage handled but in PROFITS PER INVESTMENT!

No matter how many "big fellows" you own, you can also *profitably* own an Insley or more!

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Tilting and Non-tilting Mixers, Pavers, Weigh-Mix.

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Trench Excavators, Backfillers.

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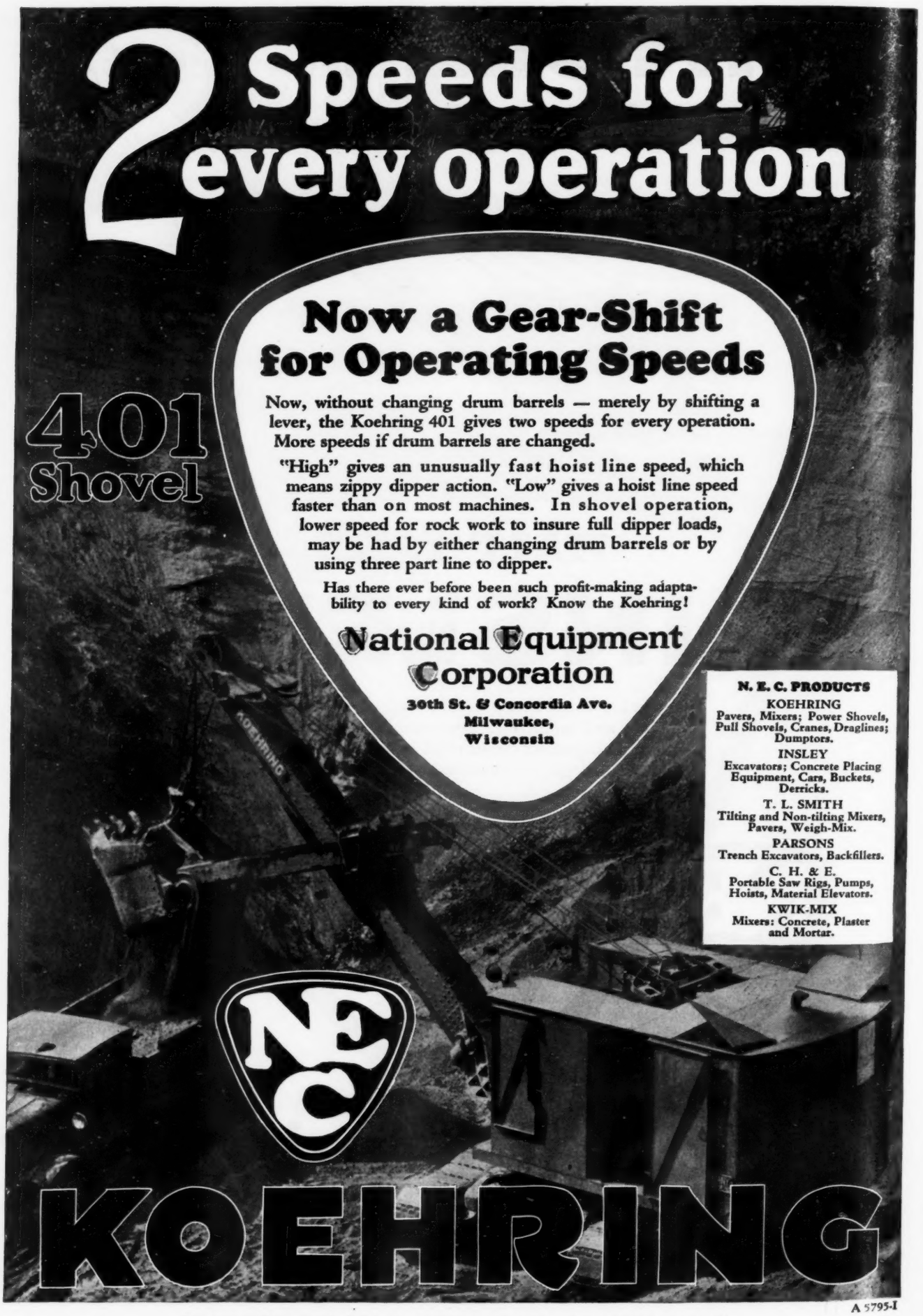
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Now a Gear-Shift for Operating Speeds
Now, without changing drum barrels — merely by shifting a lever, the Koehring 401 gives two speeds for every operation. More speeds if drum barrels are changed.
"High" gives an unusually fast hoist line speed, which means zippy dipper action. "Low" gives a hoist line speed faster than on most machines. In shovel operation, lower speed for rock work to insure full dipper loads, may be had by either changing drum barrels or by using three part line to dipper.
Has there ever before been such profit-making adaptability to every kind of work? Know the Koehring!
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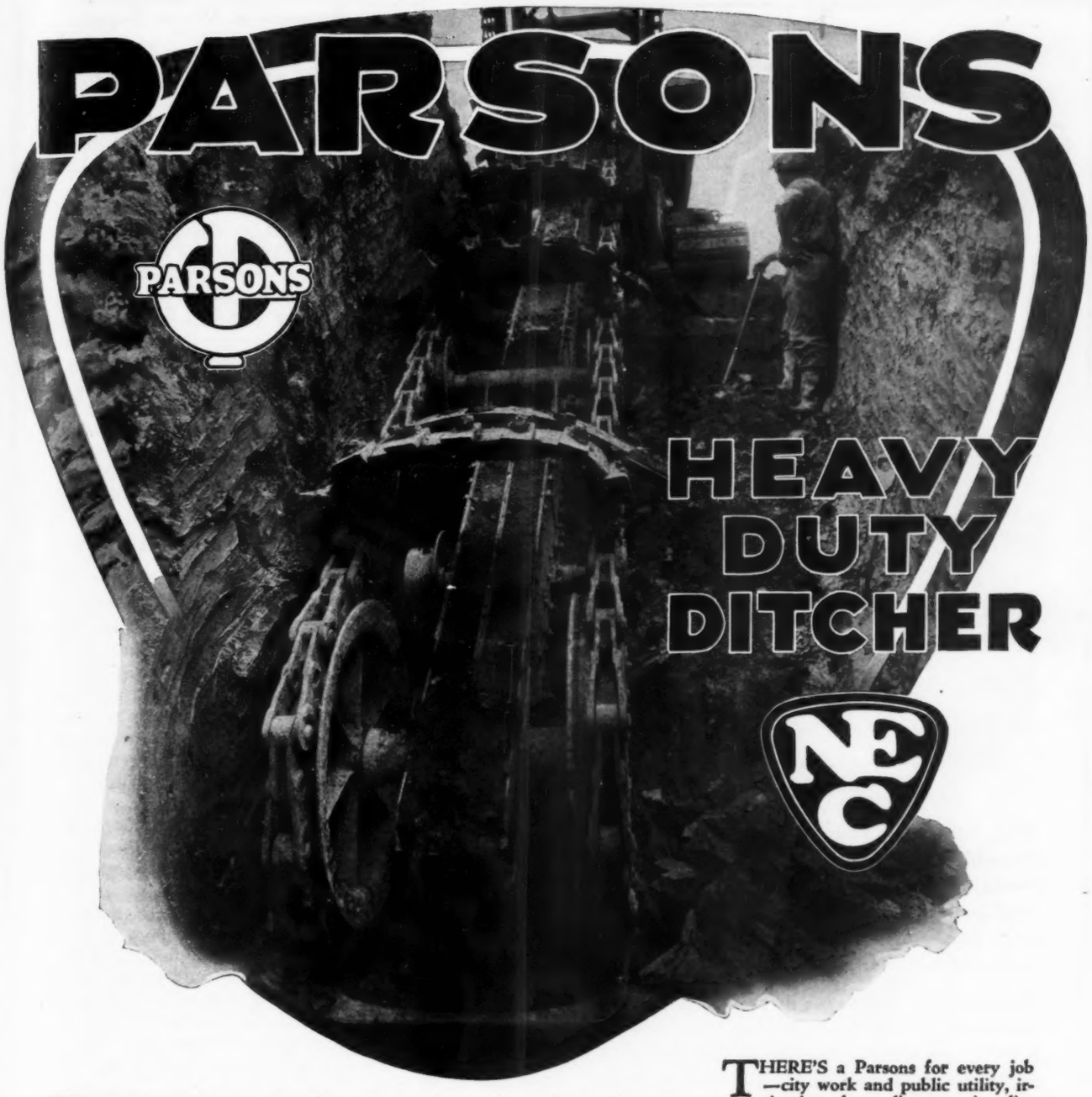

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It is the adaptable ditcher with the range of digging, traction and conveyor speeds to meet every ground condition—with the offset boom that digs in center or towards either side of the machine and within inches of curbs or poles, and with a conveyor that spills on either side!

THERE'S a Parsons for every job —city work and public utility, irrigation, long distance pipe lining — and every one is Heavy Duty! *Write N. E. C.*

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PORTABLE AIR COMPRESSORS

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Recent Progress in Water Supply

(Continued from page 23)

solution, together with washing of the sand by a ½-in. nozzle jet.

At Cleveland, Ohio, throughout 1929 the rate of sand expansion during filter washing was maintained at approximately 50 per cent, and Mr. W. C. Lawrence reported a reduction of about 11 per cent in wash-water requirements as compared with the previous year when filters were washed by a uniform rate of application of wash water. Due to this change in method, about 36,000,000 gal. of costly wash water were saved, and filter runs were materially increased without deterioration of the filter effluent. Maintenance of a constant rate of sand expansion during filter washing has likewise proved advantageous at the new St. Louis plant.

Odor and Taste.—Phenolic and chloro-phenolic odors, due to wastes from by-product coke ovens, from gas-works, and from some wood distillation processes, have been extremely troublesome, especially in the Middle West, and new methods have been devised for their removal. Super-chlorination followed by dechlorination is efficient in some cases, notably at Toronto, Ont., Canada, but in others it has been found of little value.

Progress has also been made by recovering the objectionable by-products at the coking plant before the wastes are discharged. The evaporation of these wastes by using them to quench the glowing coke from the ovens, which method was unsatisfactory to the manufacturer, is being supplanted by phenol recovery processes based on absorption of the phenolic bodies in scrubbers using light oil, benzene, or caustic soda. The patented Koppers process, efficient in several cases, which uses caustic soda as an absorbent, and which is said to recover from 95 to 98 per cent of the phenols, has recently been installed at Hamilton, Ohio, at a plant which has a daily coking capacity of 1200 tons.

Baylis, at Chicago, Ill., and investigators abroad, have shown experimentally the efficiency and economy of activated carbon for removing odor due to excessive chlorine or to chloro-phenols. By its use, waters may be over-treated with chlorine, and unpleasant tastes removed with little trouble, at an estimated cost, at Chicago, of $1.50 per 1,000,000 gal. The largest installation of activated carbon filters is the recent one at Barmen-Elberfeld, Germany.

River waters highly polluted by sewage and certain trade wastes sometimes have unpleasant odors and tastes even after treatment with chlorine and coagulating chemicals followed by filtration. These are due to byproducts of decomposition. Intensive chemical treatment does not remove them, but treatment with activated carbon is effective and satisfactory.

Pre-ammoniation as a preventative of chloro-tastes as suggested by Sir Alexander Houston, of London, McAmis, of Greenville, Tenn., and others, has been successfully used by Mr. C. H. Spaulding, at Springfield, Ill., in treatment of Sangamon River water which has a high *B. coli* index. Treatment with ammonia prior to chlorination increased the efficiency of the latter process and prevented occurrence of tastes due to chlorine and chlorine compounds. The process is especially efficient when the water has a normal or low pH-value. The process has also been investigated extensively at Cleveland, Ohio.

Among the large plants which have gone into service recently is the plant at Providence, R. I., where both

△△△ Little Points that loom big later △△△

What chance has a valve to leak when each disc is under equally distributed pressure *from four separate points?*

ONE man using one hand in the center of the disc illustrates the way pressure is applied . . . in all other valves . . . *at one point in the center* of the disc.

Two men using both hands shows how Columbian valves are closed by pressure at *four equally distributed points toward the outer edge of the disc.*

Discs . . . even those of the finest materials and workmanship . . . generally become slightly worn or warped through years of service. And when pressure is applied at only one point . . . in the center of the disc . . . it is almost impossible to keep such a valve from leaking. This possibility is eliminated entirely by the Columbian principle for in COLUMBIAN valves the discs are under equally distributed pressure from *four separate points* toward the outer edge of the disc.

In opening COLUMBIAN valves, the exclusive Columbian designed wedges *remove all pressure* of discs against seat rings *before the gates are lifted.*

And . . . in closing COLUMBIAN valves . . . *no pressure* is applied to the discs *until they are lowered into position.* This prevents warping or springing the discs through pressure being applied before the discs are in position and also prevents wear on the seat rings and disc rings caused by scraping across each other.

Isn't this the simple, trouble-proof valve you want for your city?

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influent and effluent are aerated, and where the mixing and coagulation processes have followed the results of recent research; also, two plants for handling hard and turbid waters at Kansas City and St. Louis, Mo.

At the two Western plants large quantities of silt have to be handled, and mechanical apparatus similar to that of sewage treatment practice has been installed for the continuous removal of the results of both plain subsidence and coagulation. The preliminary tanks, or clarifiers, at Kansas City are circular, whereas those at St. Louis are square. At St. Louis a period of 2½ hours is allowed for removing the silt by plain subsidence, after which chemicals are applied and the treated water is passed through circular mixing tanks. Then follows a 2½-hour period of coagulation in mechanically cleaned clarifiers, from which the sludge is pumped back into the preliminary subsidence clarifiers. It will be noted that, in these plants, the main improvements are the use of mechanical devices to replace cleaning by hand, and the utilization of the coagulating effect of sludge from the coagulating basin on the silt contained in the raw water.

At St. Louis, it is proposed to over-treat the water with lime and re-carbonate the lime-treated water before filtration, following the practice at plants which are concerned primarily with softening of water, such as Columbus and Newark, Ohio, and South Pittsburgh, Pa.

Water Softening.—This oldest of purification processes has perhaps been changed the most of all during the past three years.

Through the work of Mr. C. P. Hoover and others, the Clark process, now more than eighty years old, has been improved by adding lime in excess, thereby precipitating the magnesium as hydrate and reducing the hardness of the treated water to 25 or 30 parts per million instead of the 60 or 80 parts per million that formerly obtained in municipal practice. The excess lime is removed by subsequent treatment of the causticized water with carbon dioxide gas. Carbon dioxide in concentrated solution is also used to prevent and remove accumulations of carbonates in filters, which were long a troublesome factor in the softening process.

Sodium aluminate is used in some cases in connection with the lime and soda process to provide better coagulation and removal by filtration of the chalky turbidity which resulted from treatment with lime and soda. Ferrous sulfate also has been used for this same purpose for several years.

Great progress has also been made in the softening of water for stationary and locomotive boilers. Here heat treatment is extensively used to complete the softening reaction, and the chemical treatment has been carefully studied and greatly improved, especially that of waters for modern high-pressure boilers.

The physical and mechanical improvements in the coagulation process which have been used so beneficially for color removal, have been found really essential in the softening process. Here, because of the great bulk of precipitate to be handled, mechanically stirred, and cleaned, re-action tanks and settling basins are rapidly coming into favor. The use of mechanical devices favors the pumping back of sludge to promote precipitation in the basin by increasing the mass of precipitate, an advantage long known to chemists, but not readily taken in practice until the introduction of these mechanical devices.

While the lime-soda process is the one most commonly used, the zeolite process, either alone or as a supplement to lime treatment, is coming into favor for municipal use. The choice between zeolite and soda treatment is determined largely by the relative costs of soda for softening and of salt for regenerating the zeolite.

The first large zeolite plant, that of the Ohio Valley Water Company, has been followed by one at Sewickley, Pa., in which zeolite made from glauconite (green sand) takes the place of the sand in the usual mechanical filter plant. The former of these plants has been in successful operation for more than two years; the latter is newer, but good reports are given of it. In 1928, the Village of South Orange, N. J., installed a zeolite filter, using an artificial zeolite (Doucil). This plant has been in successful operation for about a year. Artificial zeolites have the advantage of greater softening power, but cost more per pound. This additional cost, however, is often outweighed by the higher efficiency and, consequently, the smaller size and cost of the softening apparatus. Most zeolite processes are controlled by patents.

General.—The battle against water-borne typhoid fever has been nearly won, and there are but few supplies in American cities which are unsafe from a sanitary standpoint. Many of the safe supplies, however, are disagreeable and, as standards rise, more and more attention is being given to obtaining waters which are soft and of good appearance. It is in this field that the greatest progress in the art of water purification is being made, and it is in this direction that the older processes are being improved and that more knowledge is resulting in better practices.

Steps for the development of additional sources of water supply adequate for contemplated future needs of great metropolitan areas have recently caused two noteworthy actions at law in the Eastern States to determine rights to the waters of interstate streams.

The States of New Jersey and Pennsylvania have petitioned the United States Supreme Court to prevent the City of New York from carrying out plans for the diversion of a part of the waters of the Upper Delaware River as an additional source of municipal water supply. This suit was instituted after failure of the Legislatures of Pennsylvania and New Jersey to ratify Tri-State Compacts which had twice been proposed between these two states and the State of New York.

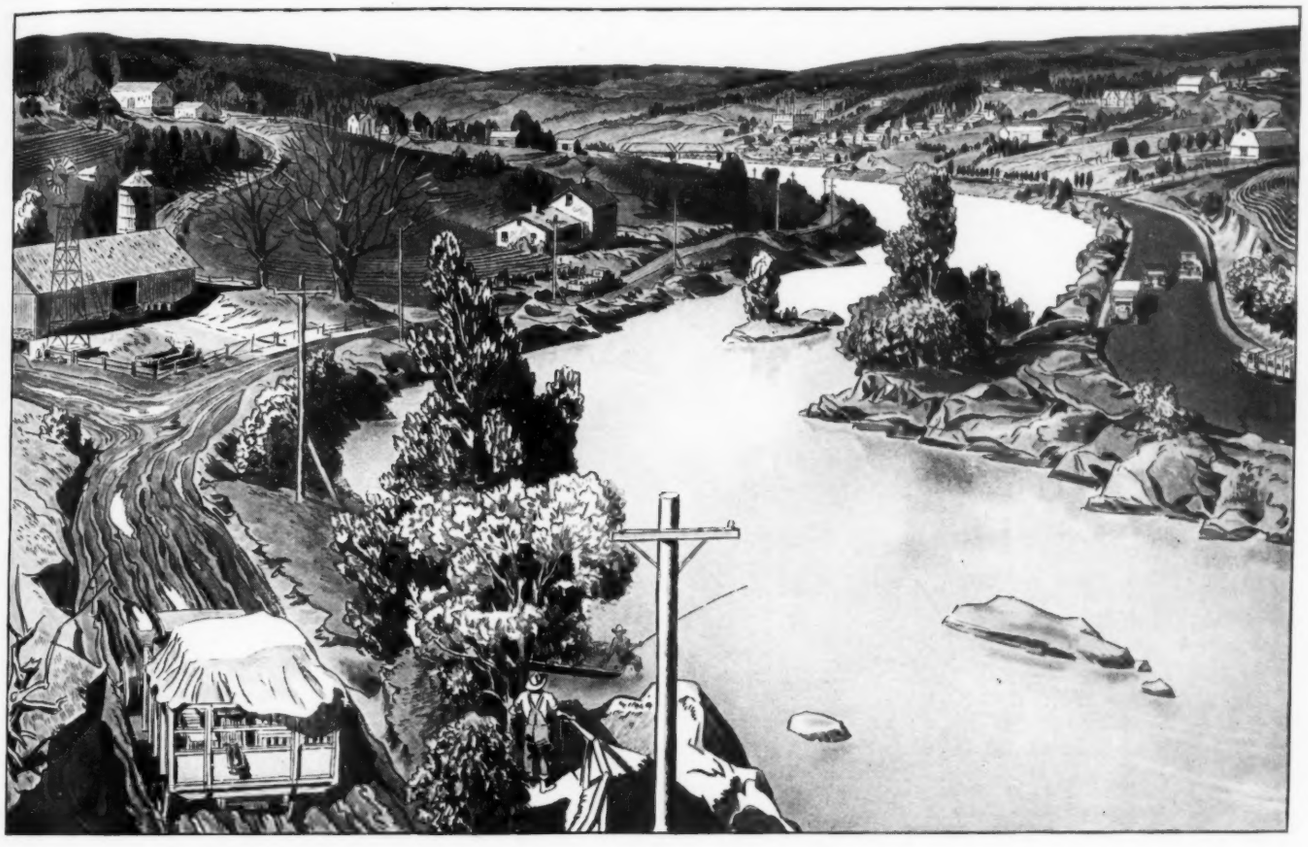
The other action refers to the Connecticut River and was instituted in the United States Supreme Court by the State of Connecticut against the Boston Metropolitan District Water Supply Commission to enjoin diversion of the waters of the Swift and Ware Rivers which are tributaries of the Connecticut, through the Chicopee River.

Stacking Cast Iron Pipe

In Fort Worth, Tex., all pipe up to 12-inch is stacked in cribs, bells alternate. Six-inch pipe is stacked twenty per tier; 8-inch, sixteen per tier; 10-inch, thirteen per tier; 12-inch, eleven per tier. All cribs are approximately square and one foot longer than the pipe dimensions. In this way, pipe can not fall, and can only be removed from the top of the crib.

In unloading, two four by six-inch skids are placed from the side of the car to the ground, and four skids on the ground—two near each end of the pipe. Sizes of pipe from six to ten-inch are lifted to skids and rolled from the side of the car to the ground, and then from the end of the second skid to the ground. Pipe 12-inch in size and larger is handled with winch and revolving crane.

Take the Far out of Farming



Seventy-four per cent of the nation's 6,300,000 farms lie on plain old-fashioned mud'n'dirt roads—roads that look more like the year 1830 than 1930. Many farms fifteen miles from market over smooth, all-year highways are more accessible than others only four miles away on unimproved—and often impassable—roads.

Put a fair proportion of road funds into Tarvia construction and maintenance and you have a practical solution of the farm-to-market road problem. A Tarvia program enables any community to have easy-riding, traffic-safe, storm-proof highways—quickly and without excessive taxation. With Tarvia, any road can be developed through progressive stages, keeping it at all times suitable to the load it must carry.

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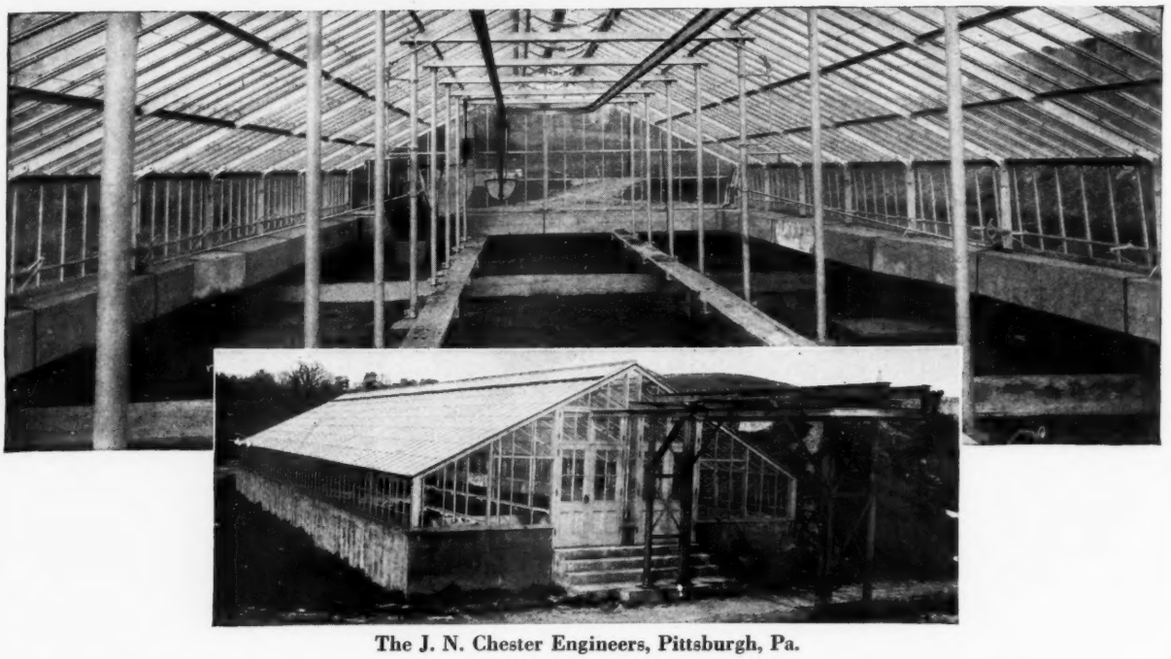
GOOD ROADS at LOW COST

Master Construction Glass-Overs for Sludge Beds



The J. N. Chester Engineers, Pittsburgh, Pa.

Facts Concerning the Disposal System At New Lexington, Ohio

THE plant is designed to treat an average flow of 500,000 gallons per day, serving a population of 5000. In addition to the one Lord & Burnham Sludge Bed Glass-Over for speeding up the drying of the sludge, the equipment consists of the following:

(1) An automatic sewage pumping station.
(2) Coarse Screens.
(3) 4 Imhoff tanks.
(4) Dosing tank.
(5) A trickling filter.
(6) A humus tank equipped with Dorr Thickner.
(7) A laboratory and general service building.

The sewer system is strictly sanitary, and consists of more than 20 miles of sewers, ranging in size from 8" to 18", all constructed according to the engineers' plans and specifications, simultaneously with the construction of the sewage disposal plant.

The city has passed a sewer rental law whereby each household, industry, and public building is charged for the services rendered by the sewerage system and sewage disposal plant, thus providing operating funds for this purpose.

The Glass-Over itself, is the latest in design and construction, giving quick drying results and insuring long life to the structure. No other construction has the same proven practicalness and endurance. Send for full particulars.

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RECENT LEGAL DECISIONS

By John Simpson

EFFECT OF WATER COMPANY'S SALE OF SYSTEM TO CITY ON FREE WATER

The North Carolina Supreme Court holds, Board of Trustees v. City of Henderson, 146 S. E. 808, that a water company's sale of its property to the city and the surrender of its franchise in effect repealed the ordinance granting the franchise, which required the furnishing of water to public schools; but the schools were held entitled to water free of charge until notice was given them of the city's intention to make a charge therefor.

AGREEMENT FOR CONSTRUCTION OF OPEN DITCH GIVING CONTRACTOR SOLE USE OF SEWAGE HELD VALID AND ENFORCEABLE

Since under the charter of the city of San Antonio, giving power to construct sewers, there was implied authority to arrange for ultimate disposal of sewage, and there was no direction as to the manner of exercising that power, the Texas Commission ot Appeals holds, City of San Antonio v. San Antonio Irr. Co., 12 S. W. (2d) 546, that sound discretion was lodged in the city's councilmen to determine what means should be employed for disposal of sewage and safeguarding of health in that regard. Period of time in which the arrangement should exist was a matter of discretion and, of itself alone, a matter beyond judicial control.

A contract between the city and the contractor for the construction of an open ditch to dispose of sewage from the city's existing outfall sewer, under which the contractor was given the exclusive use of all sewage running through the existing sewer and other parallel outfalls which might be constructed was held not void as creating a monopoly. The court said: "While sewage has elements of value and may be subject to commerce, its inherent qualities are such as to warrant its seizure and complete destruction by or under state or municipal authority. Its purchase (or receipt otherwise) from a city is not of common liberty or in virtue of right given by law. An entirely different situation is presented in regard to sale, etc., of useful and innocent articles to consumers—water, e.g. In City of Brennan v. Brenham Water Co., it is plainly recognized that there are 'certain classes of exclusive privileges which do not amount to monopolies', 67 Tex. 561, and in our opinion, this 'privilege', so called, is one of them."

An agreement to construct and maintain the ditch over a 99-year period was held specifically enforceable in a suit by the city, public policy not preventing the performance.

RECOVERY FOR COMPLETION OF SEWER AFTER EXHAUSTION OF FUND PROVIDED THEREFOR

Where there was no agreement as to the amount to be repaid a sewer contractor for completing the sewer with his own funds after the expenditure of the fund provided therefor by the sewer improvement district, the Arkansas Supreme Court held, Sewer Improvement Dist. No. 1 v. Duggans, 12 S. W. (2d) 411, that the contractor could not recover more for such work than the reasonable value thereof as upon quantum meruit. Such reasonable value was a question for the jury.

WATER FRANCHISE BY COUNTY HELD NOT EXCLUSIVE AS AGAINST CITY THEREIN

The right of a municipality to grant a franchise to construct a water system to supply water for the use of itself and its inhabitants for a limited period, exclusive even as against itself, is well settled. But it is equally well settled that a grant of such rights and privileges is strictly construed, and whatever is not unequivocally granted is withheld. Nothing passes by implication.

The Circuit Court of Appeals, Ninth Circuit, Southern California Utilities v. City of Huntington Park, 32 F (2d) 868, holds that a grant by a county board of supervisors of a 30 year franchise, to construct and maintain water systems withirf the county for supplying water for domestic purposes and for irrigation, was made by the board as a mere agent of the state and not as a municipal corporation,, and the agent was powerless to limit the authority of its principal, and made no attempt to do so. The grant was not exclusive, and an assignee of the franchise could not enjoin a city located within the county from laying a system of pipes and pipe lines in its streets and public places to supply water to the inhabitants for domestic purposes on the ground that such action would impair the obligation of the contract contained in the franchise.

WATER CERTIFICATES PAYABLE OUT OF WATER FUND; CONTRACT FIXING WATER RATES

If the legislative authority to fix and enforce reasonable rates to be paid public utility corporations for the services performed by the latter be reserved, that power does not include the right to fix rates so low as to be confiscatory of the property of the utility companies. It is equally well settled, however, that if the public service corporations and the legislative agency dealing with them have power to contract as to rates, and carry that power into effect by agreeing upon the same, the enforcement thereof is controlled by the terms of the contract, and in such case the question as to whether rates are confiscatory is immaterial and irrelevant. Southwestern Iowa Electric Co. v. Charlton, 255 U. S. 541, 542.

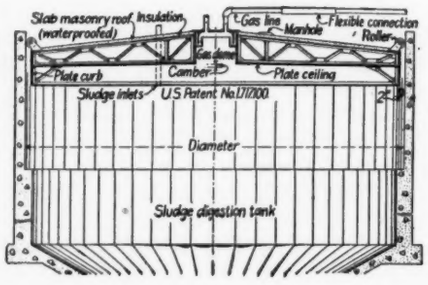
Applying these rules, the federal district court for eastern Illinois, Karel v. City of Eldorado, 32 F (2d) 795, holds that a city which purchased a water plant and issued water certificates had power, under Illinois Laws 1899, p. 104, authorizing municipalities to issue certificates of indebtedness for the purchase of water utility plants, payable only out of the water fund, to enter into a valid contract with the certificate holders fixing rates to be charged for water; and where they did fix rates for water under such a contract with the security holders, but the rates were insufficient to pay income to the security holders, the court could not grant any relief by increasing the rates, since the court could not usurp governmental power lodged in other departments of the government.

The contention that there was an implied obligation on the part of the city to charge such water rates as may be necessary to pay the certificates, on the theory that the promise to pay the certificates carried with it such an implication, was not sustained.

DOWNES Floating Covers

for

Separate Sludge Digestion Tanks



PROVIDE for variation in sludge content which flexibility does not exist under fixed types of concrete roofs.

They reduce initial and daily operating costs as well.

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800 ROOMS WITH BATH

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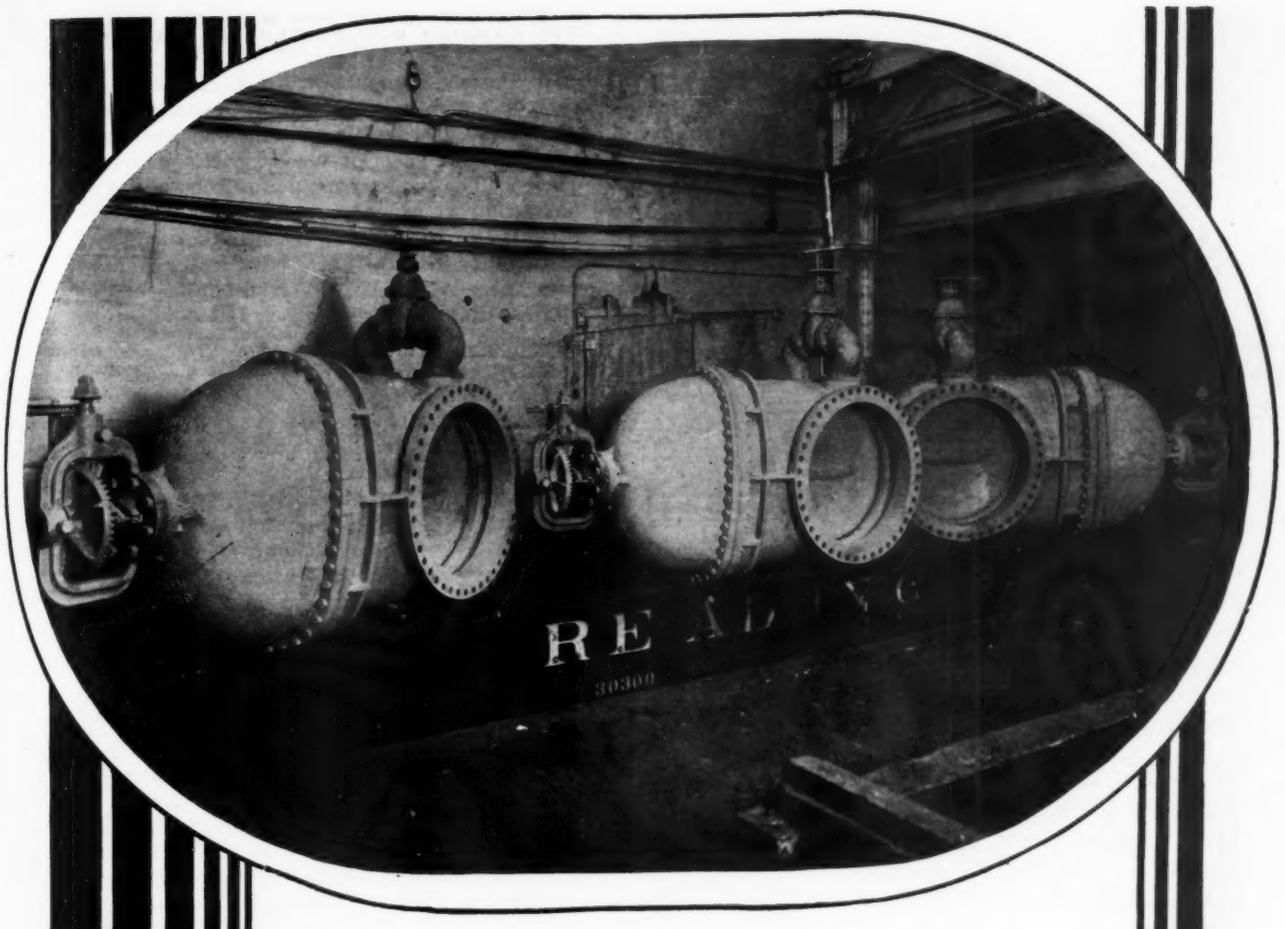
The prayer for increase in rates was made in proceedings for foreclosure of a mortgage on the water plant securing the water certificates, in which suit a receiver had been appointed to operate the property. The court would direct the receiver to operate the plant so as to produce sufficient revenue to pay the expenses of administration and operation, if that were necessary, but would not direct him, merely because he was the court's receiver, to collect funds sufficient to pay interest on the securities. Such relief, it is held, must be sought on other grounds.

STATUTORY AUTHORITY TO MUNICIPALITY TO SELL WATER BEYOND ITS LIMITS.

Missouri Rev. St. 1919, § 9079, authorizes and empowers cities to own and operate waterworks. Section 9083 authorizes and empowers cities owning waterworks to supply water to other municipal corporations and persons and private corporations beyond the limits of such city, and to enter into contracts for such time and upon such terms and under such rules and regulations as may be agreed upon by the contracting parties. The Missouri Supreme Court, Public Service Commission v. City of Kirkwood, 4 S. W. (2nd) 773, holds that there is nothing in the Public Service Commission Act having the effect of repealing these sections, although section 10425, subd. 7, subjects a municipality supplying water beyond its corporate limits to the supervision of the commission as to service and rates. Notwithstanding the latter section, the court holds that section 10481, requiring a water corporation to secure the permission and approval of the commission before beginning construction of a water system, may not be extended to include a municipality supplying water beyond its corporate limits, and that the Public Service Commission Act neither expressly nor impliedly authorizes or empowers the commission to require a municipality to obtain a certificate of convenience and necessity to supply water to persons and private corporations beyond its limits.

POWER OF MUNICIPALITY TO SELL SURPLUS WATER BEYOND ITS LIMITS.

The power of a town to establish waterworks is conferred for the benefit of its own citizens, but the power to take is not limited to its present needs. Statutory authority to construct waterworks for the supply of the town's inhabitants confers no authority on the town to supply water generally to those who live beyond its corporate limits. But a municipality may sell to persons beyond its corporate limits its surplus water, lawfully acquired. The measure of expense which a town may incur in disposing of its surplus supply of water should be governed by the town's sound judgment. The town may lay pipes (if otherwise authorized) to sell such surplus water and is liable for the necessary expense incurred in so doing. The fact that water through the pipes may at times be improperly sold is a matter which does not concern the contractors. It is a common custom for municipal corporations in Virginia to furnish water to those who live beyond their limits, and the Virginia Supreme Court of appeals holds, in an action for work and materials furnished for the construction of a water main for the town, Corporation of Mt. Jackson v. Nelson, 145 S. E. 355, that the question when municipal corporations should sell surplus water from their water systems to those living beyond their limits should be left to the sound judgment of the municipalities themselves.



Total of FORTY-TWO Big SMITH BY-PASS VALVES for WANAQUE PROJECT

THREE of the forty-eight big Smith By-Pass Valves furnished by this company for the great Wanaque Dam project of the North Jersey District Water Supply Commission are shown above.

These are 48-inch double flanged valves with bevel gearing and 8-inch by-passes and indicators. They are shown on flat car, ready for shipment.

The forty-two big valves of which these three form a part are only a fraction of the total number of valves furnished by The A. P. Smith Manufacturing Company on this contract. Many others were also supplied in smaller sizes, including 36-inch, 30-inch, 24-inch and smaller.

Smith Valves will play an important part in the water-supply service of a large portion of northern New Jersey for many decades to come. It was because of their invariable dependability that they were chosen.

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While the last word upon the science of sewage treatment has by no means been written, it has been definitely determined that Liquid Chlorine is very effective in certain phases of the work.

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A contractor in submitting its bid for the construction of a public school building made a mistake of $17,941.70 by omitting to include the amount contained in one sheet of the estimate. The bid was accepted. The bid and acceptance constituted a preliminary contract which contemplated a later formal contract. The contractor breached the contract because of inability to furnish a bond. It discovered the mistake three years later and brought suit for relief against its bid and recovery of the certified check deposited with the bid. The Minnesota Supreme Court, Federal Contracting Co. v. City of St. Paul, 225 N. W. 149, held that it was not entitled to relief. The court said that in practically all the cases relied upon by plaintiff where the deposit had been recovered there was a withdrawal of the bid, or notice of the mistake was given before acceptance. Promptness was a suggested condition of relief, required by good policy. The court, however, did not specify the particular circumstances when relief will be given against a municipality for mistake, or when notice must come to it, or what delay will prevent relief.

ORDINANCE REQUIRING JITNEYS TO OPERATE ON PRESCRIBED ROUTES HELD VALID

The South Carolina Supreme Court holds, Huffman v. City of Columbia, 144 S. E. 157, that an ordinance of the city requiring jitneys to operate on prescribed routes and schedules is valid under S. C. Act March 2, 1871, § 10, Civ. Code 1922, § 4727 and Acts 1928, p. 1229, providing for the control by cities of between 30,000 and 50,000 population of transportation by motor vehicles. The court said: "No one has the inherent right to carry on his private business along the public streets. Such rights can be exercised only under terms and conditions imposed by the city authorities."

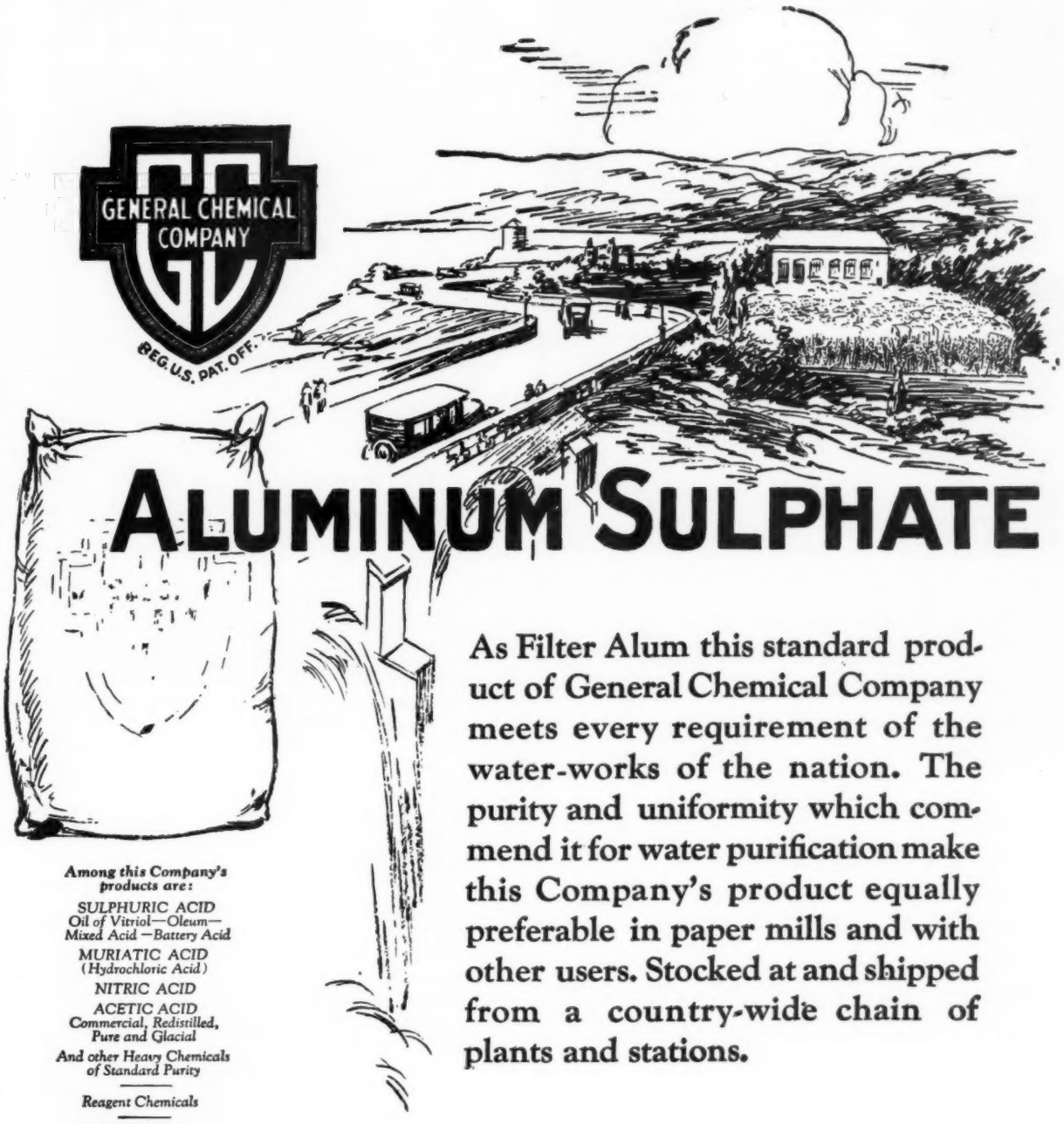
UNAUTHORIZED COMMERCIAL RAILROAD IN CITY STREET.

In the absence of express legislative authority, a municipality has no power to grant the use of streets for private purposes, and abutting owners who suffer special damages by reason thereof may have appropriate remedy to prevent such use or recover damages therefor. The Virginia Supreme Court of Appeals says, McClintock v. Richlands Brick Corporation, 124 S. E. 425, that it seems to be generally held that the construction of a commercial railroad, as distinguished from a local street railway, upon a street without authority is a nuisance, and also that the unlawful obstruction of a highway will generally support an action by an abutter who is specially injured, though it may not constitute a taking of his property.

VALIDITY OF OCCUPATION TAXES.

The power to tax an occupation is not dependent upon and limited by its ability to earn a profit as the business or occupation is conducted. There may be competition or negligence or other contributing causes or considerations entering into and affecting the extent of business or ability to earn a profit.

A taxing statute is not void if in the administration of the law the classification is reasonable and its application or administration does not offend the requirements as to equality. Warrior Water Co. v. Long, Alabama Supreme Court, 117 So. 656.



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Making the Road Money Go Further

(*Continued from page 25*)

Mulch Treatment

The next type of coarse gravel roads includes those which have an appreciable depth of loose aggregate on the surface. The road is maintained by blading or dragging this loose material over the road surface frequently.

In treating a gravel road of this sort, the loose material is bound together with tar and this tar-gravel mixture tightly fastened to the solid material underneath. About one to one and one-half inches thickness of loose material gives the best results. The gravel should contain at least sixty per cent of aggregate above one-quarter inch in size.

The treatment operations are as follows:

1. Apply about one-third gallon per square yard of cold refined tar to the loose material over the entire road surface. Permit this to soak into the gravel for from two to twenty-four hours.
2. With a blade grader, move the treated material on one side of the road to a line a little past the center of the highway, piling it in a windrow near the center of the roadway.
3. Apply approximately one-third gallon per square yard of cold refined tar to the solid surface exposed by the above grading operation.
4. With the blade grader move the windrow of treated material in the center of the road back over the wet tar.
5. Repeat operations 2, 3, and 4 on the other side of the road.
6. Spread the loose tar-treated gravel evenly over the road surface and smooth out with a road grader, planer, or drag so as to prevent ruts and holes from forming in the surface. The grading or dragging operations necessary to keep the road smooth should be continued until the mix sets up, which may be anywhere from two to ten days, depending upon weather conditions.
7. Give the road a seal coat of about one-sixteenth gallon per square yard of tar, then cover with sand, pea gravel, slag, or stone chips. It is good practice to delay the seal coat until after the road has been thoroughly consolidated under traffic. Where the road shows up quite black, and it is evident that there is sufficient tar in the mixed portions, the seal coat may be omitted.

A treatment of this sort is more costly than the Double Surface Treatment but should produce more lasting results. Maintenance operations are the same as previously described. A mulch treatment should cost from $800 to $1200 per mile of eighteen foot road under ordinary conditions.

Re-treatment ordinarily is not required every year, it being possible to skip about one year in three. As a general rule, these treatments will carry through without the necessity of scarifying. The re-treatment will usually require about one quarter gallon per square yard of cold refined tar, with a stone chip, granulated slag or pea gravel cover.

Blotter Treatment

The third type of gravel is the sandy gravel containing only a small amount of aggregate above one quarter inch in size. Usually there will be about 25 per cent of the coarser aggregate, although gravels have been treated which contained as low as 6 per cent of material retained on a quarter-inch sieve.

Roads of this sort have a loose, shifting surface be-

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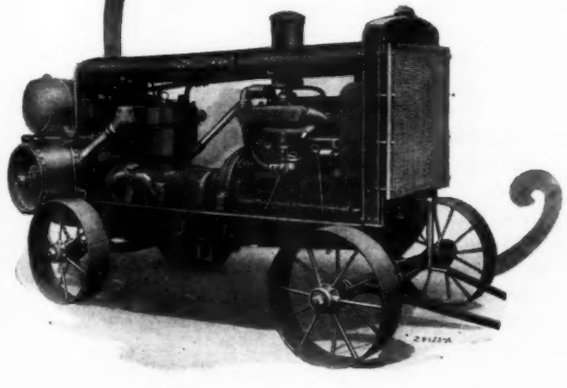
The standard I-R Portable Compressor on steel wheels and axles. There are many sizes and several types of mountings from which to choose.



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fore treatment. They are dusty, and require continuous maintenance to keep them in shape.

The steps in the original treatment of the sandy gravel type of road are as follows:

1. Blade all of the loose material from one side of the road, into a windrow in the center of the road. All of the loose material must be removed and a solid base obtained. The degree of smoothness of this hard surface will be reflected in the riding quality of the finished road.

2. Apply approximately one-third gallon per square yard of cold refined tar to the solid surface exposed. The exact amount of tar will depend upon the nature of the material to be treated. Clay will require somewhat less than one-third gallon and light sandy surfaces somewhat more. The road should have as much as it will absorb.

This first application of tar should be permitted to soak into the road for from two to four hours and then lightly covered with sand. Traffic may be permitted over the treatment.

An interval of 24 hours or more should elapse between the first and second coats of tar.

3. Sweep excess cover from the prime coat. Then apply about one-third gallon per square yard of tar of the same consistency as used on the first coat, or a heavier tar. Immediately after the application of the tar, blade the loose gravel from the windrow in the center of the road over the wet tar. Spread the layer of loose material uniformly over the treated half of the road.

4. Repeat steps 1, 2 and 3 on the other side of the road.

5. With a blade grader keep the loose material smoothed out over the road width. The blade is set just high enough to agitate the loose gravel on the surface, barely touching the top.

This work is continued until the mix begins to set up. As soon as the blade starts to pull up the surface, its work is finished.

One of the principal advantages of this method of treatment is that the proper amount of tar in the surface mulch is easily obtained. If a spot shows too much tar, additional gravel can be added. If too much gravel is present it will be whipped off by the traffic and the gravel underneath will be bound together.

A modification of the method is to lightly spray the windrow of untreated gravel with cold refined tar before it is smoothed out with the grader. This coats the particles of gravel and holds them in place.

After the road has been treated it must be maintained as previously described.

This method of treatment, and the subsequent maintenance, usually cost from $1200 to $1800 per mile of 24-foot road for the first year. Subsequent annual costs should be less.

Where the road breaks to a considerable extent, it is advisable to scarify it before re-treatment. Ordinarily only a small percentage of this type of work requires scarifying.

In re-treating, the cover material is placed in windrows along the side of the road. Heavy cold refined tar is sprayed over the prepared surface at the rate of one quarter to one third gallon per square yard, lightly spraying the cover material at the same time. This tar-treated cover is then spread over the tar with a blade grader and bladed to and fro across the road until the tar sets up. The surface is then lightly sanded

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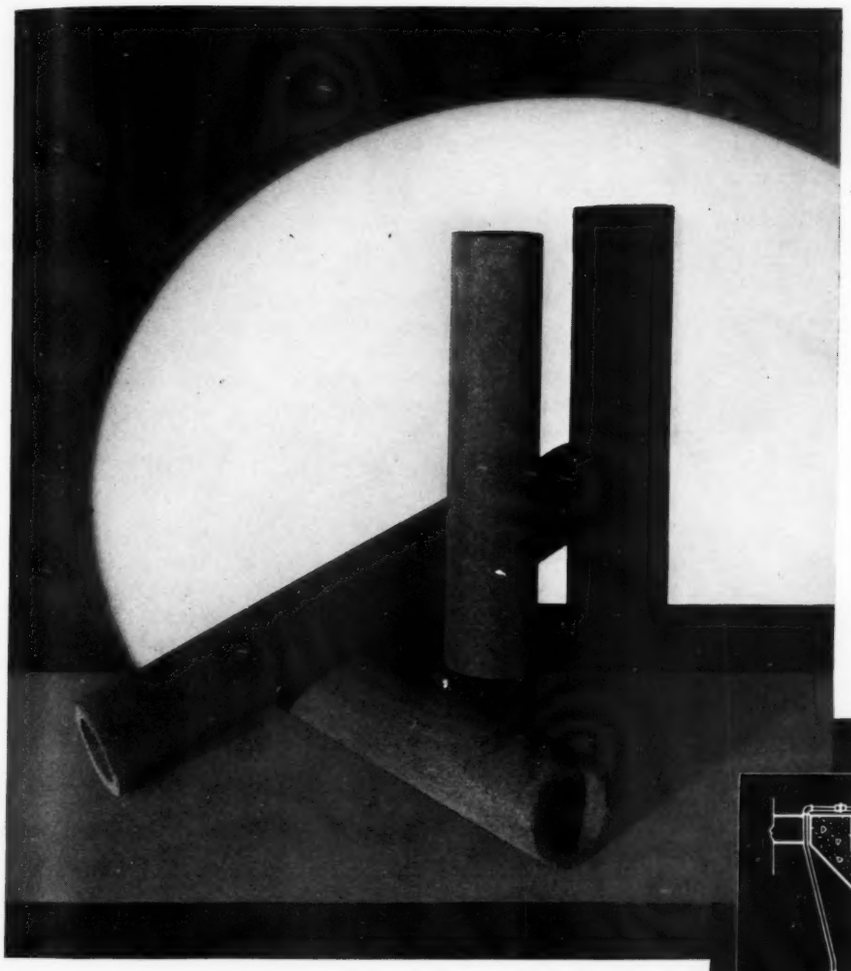

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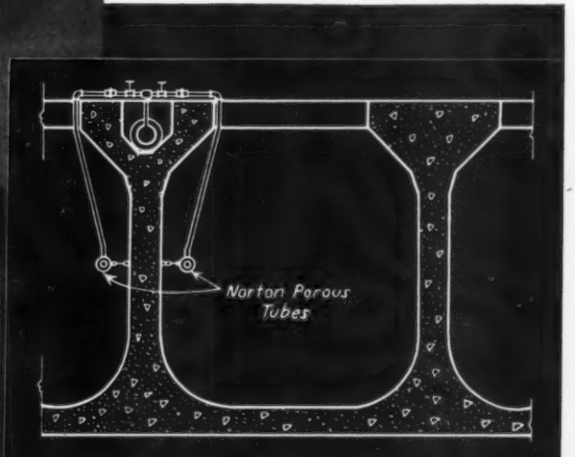

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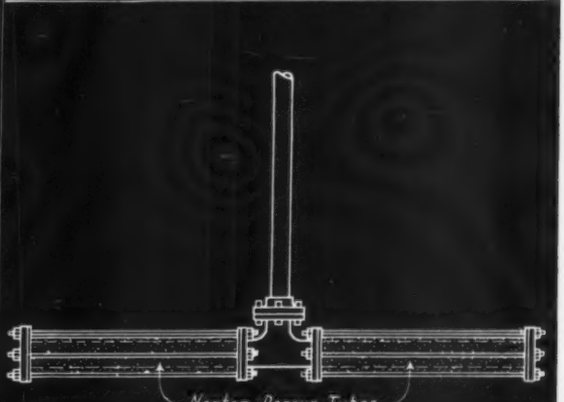

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In several of the types of treatment described above two consistencies of tar have been mentioned. The cold refined tar is one having a specific viscosity at 40°C of 8 to 13, while the heavy refined tar has a specific viscosity at 40°C of 18 to 25.

These same methods may be used to treat crushed stone and crushed slag traffic-bound roads. The same limiting conditions determine the choice of treatment. Tightly bound surfaces should be given the Double Surface Treatment, while loose, shifting surfaces respond best to the Mulch Treatment.

Surface treatments of this sort will entirely eliminate dust and loose material on the road surface. Grading or dragging operations are eliminated and the loss of gravel is instantly stopped. Roads so treated present an easy riding, tight, non-skid surface at low cost.

When the traffic becomes heavy enough to cause distress and increase maintenance costs, these roads form excellent foundations for the next step in stage construction, which is the addition of a re-tread top. This step will be discussed in the next article of this series.

Sewage Disposal at Berlin

(*Continued from page 27*)

partially chlorinated in the grit chambers (detention period about 5 min.) and by short-time aeration. The effluent still contains from 200-250 p.p.m. suspended solids, with a volatile matter content of 75%, or about equal to a medium strength American sewage.

The effluent from the Imhoff tanks is collected into a sump of 250 cu. ft. capacity and is then pumped to the irrigation fields. The gas collected from the Imhoff tanks is used for this pump. About 210,000 cu. ft. of the gas develops about 1,000 H.P. For the pumping, threee engines are used of 63, 335 and 750 H.P. respectively.

The digested sludge is dried on sand beds. It dries in the summer time in about 14 days to 80-69% moisture, but during the winter time it dries with great difficulty. The dry sludge is removed from the drying beds mechanically by scrapers and loaded upon wagons. It is sold to farmers in the neighborhood for about 4½ marks per cu. yd. It is claimed by the officials that the 60% moisture sludge is as good as stable manure for all agricultural purposes.

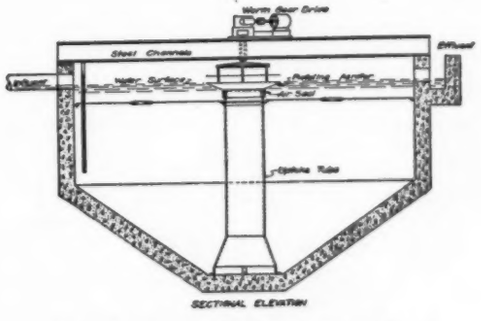
The gas is collected in equalizers and filtered through iron ore to take out the comparatively large quantities of H_2S. If this is not taken out, the pipes and engines corrode rapidly.

In spite of the value of the effluent for agriculture, this method of disposal is very expensive. On account of odors the irrigation farms must be located far from the city. In addition, pre-treatment is necessary. During the last six years the sewage flow from the city has increased from an average of 130 m.g.d. in 1923 to 170 m.g.d. in 1929, a per capita flow of about 40 gallons. During this increase in flow, the farms have not been increased, with the result that if the present sewage flow is adequately taken care of approximately 8,400 acres of irrigation fields are needed in addition to the existing farms. The cost of adding these irrigation fields would be about 170 million marks. In addition, 100 million marks would be needed for the construction of drainage ditches and another 100 million marks for the piping and pumping stations. A number of sewage farms are located close to the city limits, and with the advance of building, road making, etc., it will not be long before 10,000 acres of irrigation fields must be abandoned. To

Final effluent from the Simplex type Sewage Treatment Plant in service at Frederick, Oklahoma. Designed by the Benham Engineering Company of Oklahoma City.

The Clear, Stable Effluent

. . . shown in the above picture is one of the best reasons why municipal officials should demand Simplex aerators for sewage treatment works. An investment in sewage purification plant is, in the last analysis, the purchase of sewage purification service. That type of plant which will produce the best effluent should be worth more than other less efficient types, but a Simplex installation need cost no more than any other type plant and will produce the kind of effluent seen above without odors and gnat nuisances.



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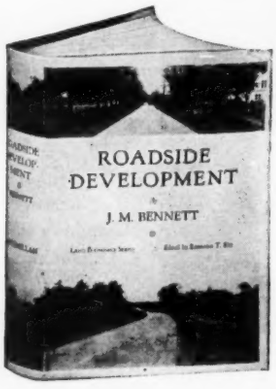

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replace these fields would cost 40 million marks, or a total for expansion of 410 million marks.

These 410 million marks are, however, not the total cost, since irrigation fields could not be utilized continuously but must be three times the surface area available to take care of the rest periods. Outside of the regular irrigation fields a large area of land is necessary on the farms, which would necessitate about 100,000 acres of natural land, which would cost about 150 million marks. Therefore, if Berlin would continue the sewage irrigation system it would have to spend, within the next fifteen years, not less than 560 million marks, or 130 marks per capita. Moreover, taking into consideration the difficulties of this system, there is not that much land available and suitable in the neighborhood.

For that reason the city of Berlin is now providing for extensive experiments in which the activated sludge process will be utilized. The first plant of this type is under construction at Stahnsdorf, which will treat from 3.1 to 4.7 million gallons daily. This plant is at present under construction and designed essentially as an experimental unit. It consists essentially of screens, grit chambers, settling tanks, (mechanical and plain) aeration units, separate sludge digestion tanks with heating, secondary settling tanks, and sludge beds. The types of aeration differ, as do the types of settling units. There is no doubt that this plant will afford a good deal of experimentation and will produce interesting data on cost and purification.

Acknowledgment

Much of this information was obtained from Dr. F. Langbein, director, and Dr. F. Kroll, chief chemist, to whom I am gratefully indebted.

Building Reservoirs Over Coal Mines

(*Continued from page 30*)

on the faces of the concrete adjacent to the water was limited to a value of 10,000 pounds per square inch. A cut-off wall was carried down from the footing to the rock at all places where the rock surface was below the bottom of the wall. The wall was made in sections of not more than 40 feet length, with vertical copper-sealed joints between construction units, each unit being formed as a monolith.

In the case of the circular McNaugher reservoirs there is no wide footing or reliance on cantilever action, but the water pressure is resisted by hoop reinforcement. There are no vertical construction joints, but the large reservoir was built in six horizontal lifts or rings, each poured as a monolith in a single day, using two mixers. Joints between successive lifts were made watertight by means of strips of copper 5 inches wide, lapped and soldered at the ends to form a continuous ring around the reservoir about 4 inches from the inner face and pushed half its depth into the lower lift while the concrete was still soft. These horizontal construction joints were, in addition, covered inside with gunite one inch thick, reinforced by light welded mesh. After completion the entire interior surface was covered with gunite.

A reinforced gunite floor was adopted for the circular reservoirs, where the diameter was only 185 feet and the underlying material is largely shale, which breaks down into clay under the action of water and offers considerable resistance to the passage of water.

In the Brashear reservoir, however, the free-draining nature of the material underlying the floor and the greater expanse of floor to be covered led to the

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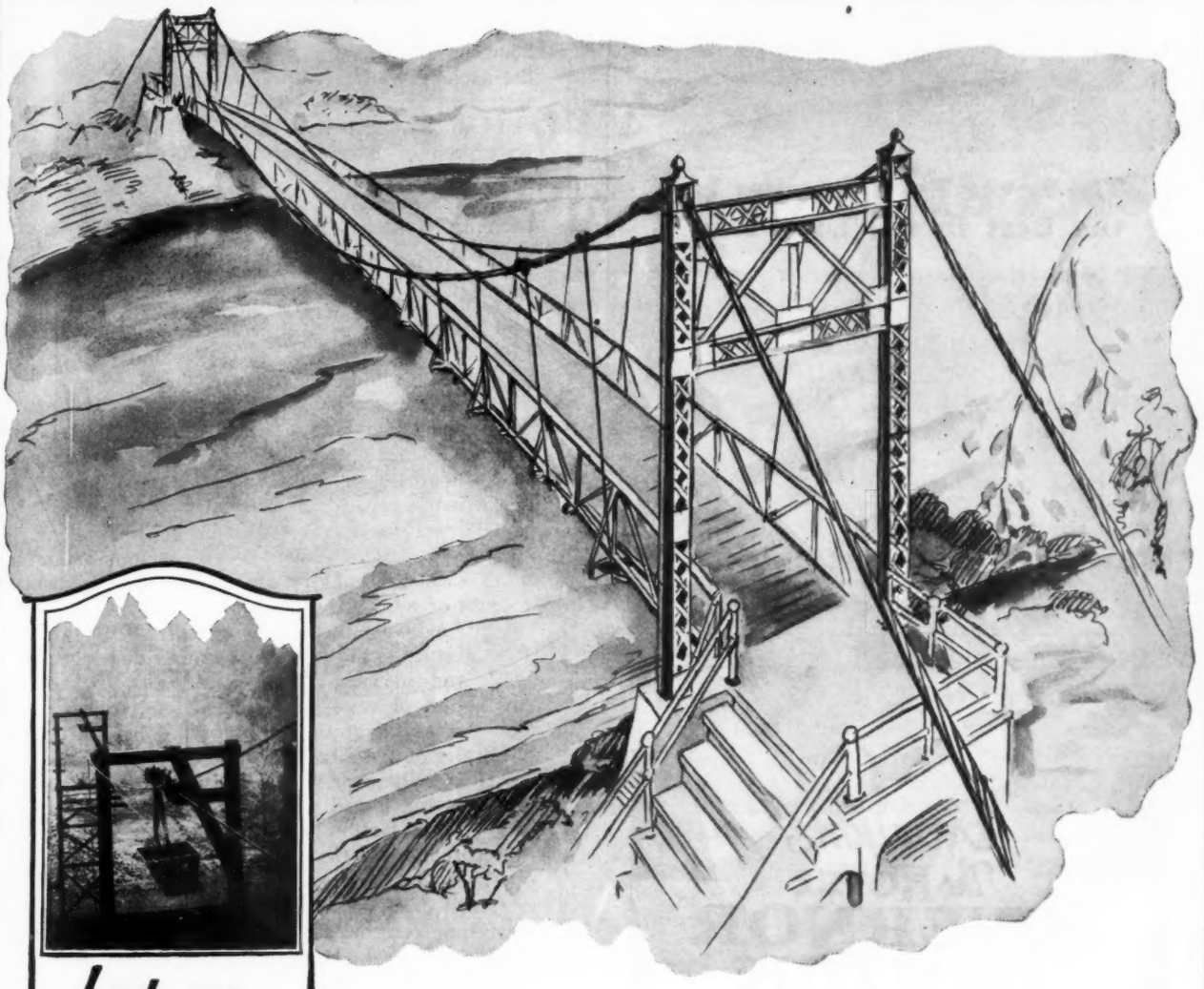

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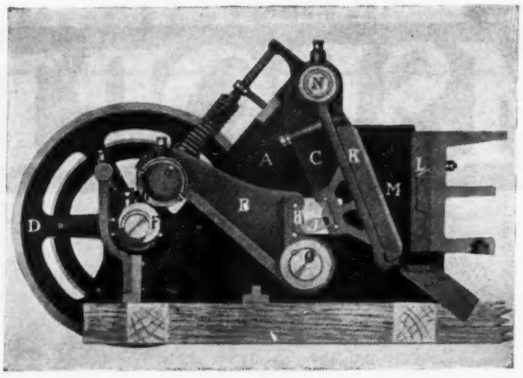

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adoption of a double concrete floor with a complete double layer of membrane waterproofing between two 4-inch layers of concrete, laid in blocks 12 by 16 feet. The bottom concrete layer was reinforced with wire mesh so that, if settlement should occur, large cracks would be prevented in the bottom slab, diminishing the probability of rupture of the membrane waterproofing and of large breaks in the floor. At the Brashear reservoir a copper strip, with end joints riveted and soldered, was incorporated into the concrete footing, leaving about 6 inches extending out for connection to the floor construction. This extension was later built into the asphalt and the impregnated cotton fabric of the waterproofing layer between the two 4-inch concrete slabs of the floor construction. By this means the waterproof membrane of the floor was tied into the concrete walls without leaving a joint through which the water might pass around and under the waterproofing.

When the hot asphalt was mopped onto the copper plates, these expanded with the heat and it was necessary to tamp the plate with a light wooden tamper a few minutes later when the copper had partly cooled, to force it into contact with the asphalt below.

In the McNaugher reservoir, the joint between the floor and the wall was reinforced with a ring of copper strips soldered together at the joints, one side of the copper being poured into the wall and the other side into the floor, with an expansion loop or crimp between the two, which was later filled with asphalt.

The concrete was mixed of proportions running ordinarily 1 sack of cement to 185 pounds of dry sand and 315 pounds of dry gravel, mixed with about 6½ gallons of total water per sack of cement, this including the moisture in the aggregates. With this rather rich mixture, some shrinkage cracks developed in the wall, and in view of these and also to check any absorption of water by the concrete, it was decided before the end of the job to paint the inner face of the walls of the Brashear reservoir with two coats of Inertol. Wherever visible shrinkage cracks appeared, this was reinforced with a layer of impregnated cotton frabric similar to that used in the membrane waterproofing of the reservoir floor.

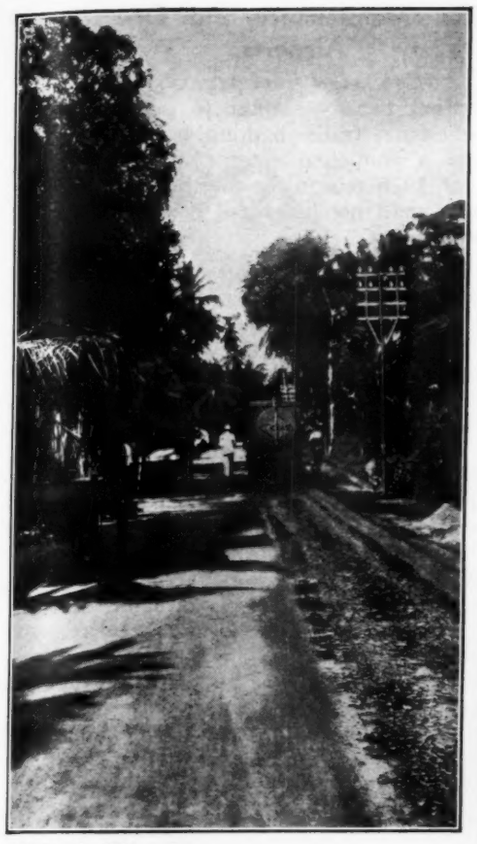
The above information and the illustrations were obtained from a paper presented by R. M. Riegel, designing engineer of the Department of Public Works and G. L. Hendrickson, designing engineer of the Bureau of Water, Department of Public Works, of the city of Pittsburgh, presented before the Engineer's Society of Pennsylvania and published in its "Proceedings" for November, 1929.

County Highway Maintenance by Contract

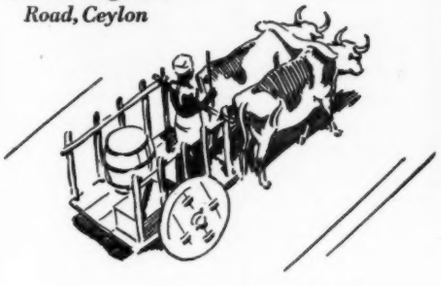
(*Continued from page 32*)

hour of the day, miles traveled, etc. Without this attachment it would be practically impossible to have an accurate check upon truck operations. Each stop for over 20 minutes is noted by the operator, giving the cause, etc., and the contractor is docked for all time over 20 minutes unless the cause is for the purpose of bettering lines of drainage or surface. Along with this recorded check on operations, the engineers inspect the roads to see that the proper amount of work is done. The period of time that the recordagraphs have been out of operation have been practically negligible. The contractor must keep these attachments in repair. In this way we will be able to

(*Continued on page 113*)



Colombo-Negombo Road, Ceylon



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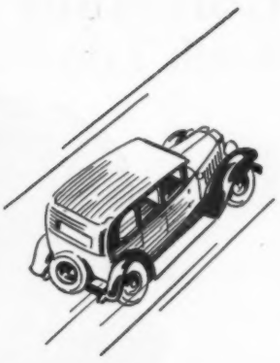

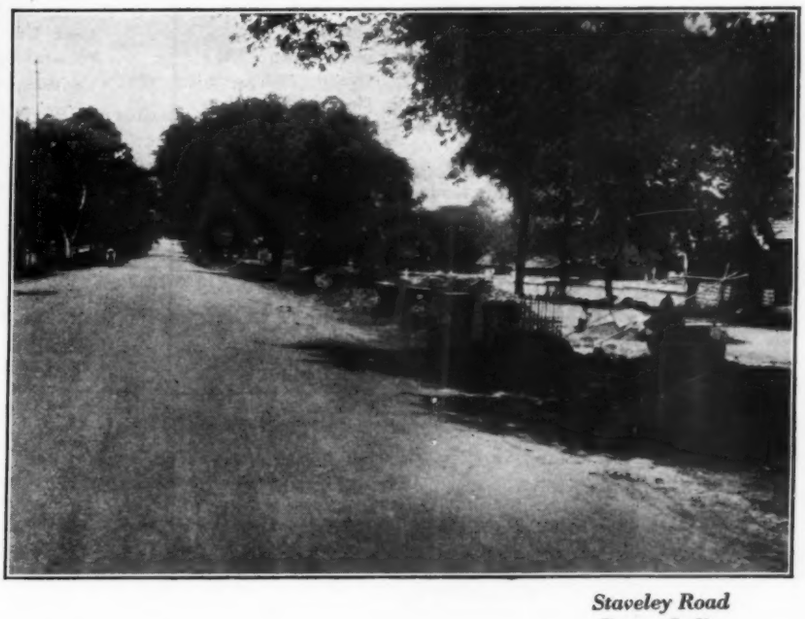

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Acquisition, Maintenance and Operation of Airports.

(*Continued from page 56*)

as a recreation facility similar to city parks, golf courses, equestrian trails, bathing beaches, etc., and it should be a municipal enterprise. The air commerce act of 1926 recognizes this by providing that civil airports shall not be owned or operated by the federal government'."

Reasons for Municipal Airport

Reasons for the establishment of airports by municipalities and the statutory authority for such establishment and maintenance by municipalities are discussed by the Kansas court as follows: "Aeronautical development emphasizes the vital importance of 'airways,' an essential element of which is the landing field or airport. The term 'airway' applies to air routes for either airplanes or seaplanes. An airway is far more than a mere air line. It is a material and permanent way through the air, laid out with the precision and care that an engineer adopts in choosing the course of and laying down of a railway. Whether over land or water, it is essentially on the ground. Its existence and general layout depend almost entirely upon the commercial demand. The primary requisite of any airway is that it shall be safe, reliable and regular. These attributes can be gained only if it is adequately laid out and equipped, and first and foremost of these attributes are airports or landing fields. The demand for more and more airports throughout the country is urgent and will continue to increase. A typical example of a modern airway is the transcontinental route between New York and San Francisco, said to be the most completely equipped airway in the world. On it, between New York and Salt Lake City, are 12 airports and 92 intermediate fields, connected by 612 electric and gas route beacons spaced along and indicating the entire distance. The electric beacons of 1,000,000 and 2,000,000 candlepower are, in general, located at or near intermediate fields and are spaced approximately 22 miles apart with the smaller gas beacons between.

"The airway is essentially a free highway. As such it is open to all qualified aircraft. It is rightly, therefore, a federal undertaking to lay out and equip airways. The maintenance of airports, however, comes legitimately within the scope of the municipality in much the same manner as docks and harbor facilities for marine shipping. Airports are said to be as important to commerce as are terminals to railroads or harbors to navigation. Municipalities are studying local conditions and commercial organizations are pressing the importance of establishing terminal airports and of providing proper lighting for landing fields, and facilities such as hangars, garages and repair shops. The possession of the airport by the modern city is essential if it desires opportunities for increased prosperity to be secured by air commerce. Lands susceptible of improvement, as parks, playgrounds, or general recreational purposes, may be utilized and developed around the modern airport so that the municipality may bring to itself not only the advantages of air commerce but afford its citizens those other inestimable advantages of improved beautification and health-giving opportunities. It is said that there were 3,800 landing fields in the United States at the close of 1926, of which 400 were municipal (See 1927 Aircraft Year Book, p. 101, et seq.)"

In any event, the court concluded, the airport or landing field is as properly included within park purposes as tourist camps and other named recreational

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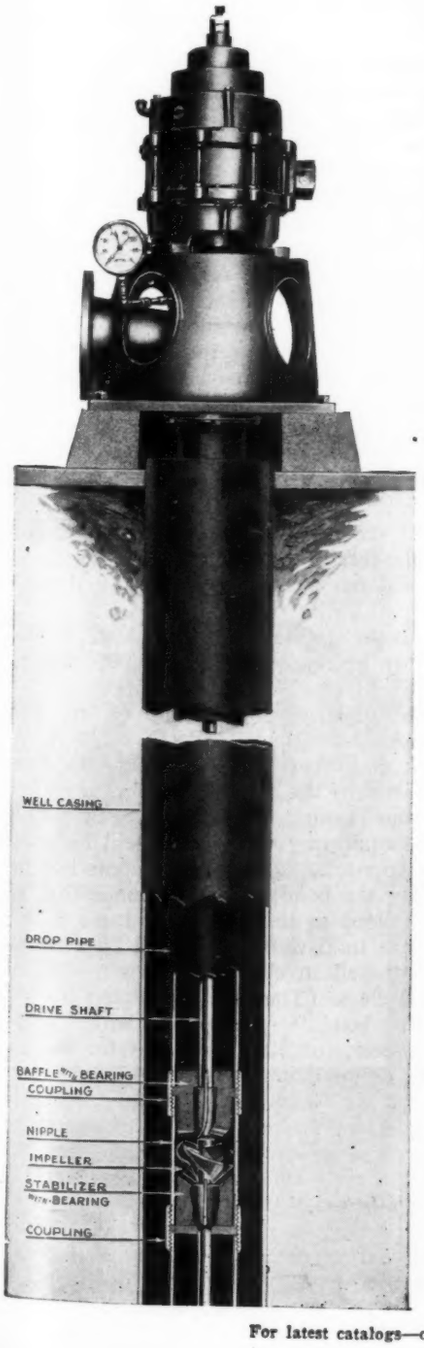

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Deep well systems are not always practicable but are certainly preferable where an abundant supply of good pure water below the surface is available.

LUITWIELER NON-PULSATING PUMPS have been the standard equipment for this type of systems for many years and the demand is continuing and increasing. In fact there is a great demand for pumps of greater capacity for the same wells or new requirements and to accommodate this desire—

"Luitwieler" announces its complete line of deep well turbines called the "Multipellor":

1—Screw type for greatest capacities from small wells, and designed to automatically adjust to varying capacities from 20 gallons per minute and up over a wide range for each size.

2—Bowl type for deeper lifts and greater pressure duty above the surface.

No Lubrication Below Ground Is Required for Multipellor Pumps

We carry in stock standard sizes to be driven by Electric Motors hollow and shaft, Gas Engine, Steam Turbine (direct connected) and Diesel Engine.

If more water is required the "Multipellor" will serve you best.

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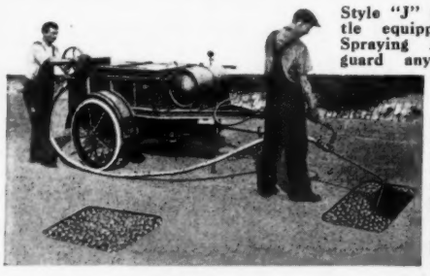

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objects, and the board of park commissioners of Wichita was held authorized and empowered under chapter 117, Laws of 1927, to proceed to purchase or condemn the lands in question, outside of and within five miles of the city limits, for the purposes stated.

The Kansas aircraft act, R. S. 3-110, authorizes a city to "acquire by purchase or lease and maintain a municipal field for aviation purposes," to be paid for out of the general funds of the city. The court considered that the provisions of this section alone are not sufficient to authorize the purchase or condemnation of the land in question (it being beyond the corporate limits of the city), but that they are sufficient to enable the governing body of the city to maintain such an airport out of general funds, the park, including the airport, having been secured under the provisions of the act of 1927.

However, another section of the statute (R. S. 12-1301 authorizes the purchase or lease of land within or without the limits of cities to be used as public parks, etc., provided the governing body is instructed to do so by a majority of votes cast at an election held for such purpose.

Submission of Loan to Voters

In Douty v. Mayor etc. of Baltimore (April 11, 1928) 155 Md. 125, the question was as to the validity of the submission to the voters of the Baltimore Airport Loan. The ballots did not contain the whole ordinance submitting the loan, but merely the title. The ordinance had been duly published and stated that the proposition to be submitted and voted on was to issue a named amount of bonds for the purchase, condemnation and improvement of land for an airport to afford landing facilities for accommodating land and sea planes, and that the funds were to be provided by a loan to be negotiated by the finance commissioners at a rate of interest to be fixed by them. It was held that the loan was properly submitted.

The fact that the title of the ordinance, printed on the ballots, did not indicate the rate of interest the loan was to carry, nor the dates of maturity of the various series of the loan, nor state that the rate of interest was to be left to the discretion of the finance commissioners, did not affect the validity of the submission.

The validity of the statute (Md. Laws 1927, c. 431) authorizing a loan not exceeding $1,500,000, was not questioned.

The Nebraska Supreme Court, State ex. rel. City of Lincoln v. Johnson, (June 27, 1928), 220 N. W. 273, held that a majority vote is sufficient, under the Home Rule Charter of the city of Lincoln, to carry a proposition to issue municipal bonds for the purpose of establishing and equipping an aviation field for aerial traffic. The state auditor of public accounts had declined to register the bonds on the grounds that the proposition submitted to the electors did not receive 60 per cent of the total vote as required by a statute applying to metropolitan cities and to cities of the first and second class. (The vote was 6,330 for and 6,173 against the bonds.) The Home Rule Charter of the City, however, contains provisions for the voting and issuing of municipal bonds for "public service property" and for "public utilities" upon a majority vote of the electors, and, since the statute relied on by the auditor does not prevail over conflicting provisions in a Home Rule Charter, it is inapplicable to the city of Lincoln.

The auditor refused to approve the bonds on the further ground that an equipped aviation field is not a "public service property" or a "public utility" with-

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JAMES H. COX
PRESIDENT AND GENERAL MANAGER

October 18, 1929.

Newport Culvert Company,
Newport, Kentucky.

Gentlemen:

In 1909, 1910 and 1911, as Secretary and Purchasing Agent of the General Road Commission of Putnam County, we bought our culverts from the Newport Culvert Company of Newport, Kentucky, and at that time same was known as the Genuine Open Hearth Iron guaranteed to last indefinitely, and after twenty years of use, I have today in company with others, examined some of these culverts that are still in use and found same to be almost in perfect condition. A section of one of the culverts was removed in my presence and upon inspection it is free from rust and seemingly good for years and years to come.

In 1916, seven years after the work had been done, I was in company with some parties who made an examination at that time and testified to their condition, and at this date, twenty years after they were installed, I find the same culverts examined at that time in use and seemingly in as good condition as they were upon that date.

A commercial photographer is today photographing a 30 inch culvert on the old Spring Creek road known as the Harve Terry Road, and this is one of the culverts that I referred to above as being in almost perfect condition and seemingly with no deterioration after twenty years of use.

Yours truly,

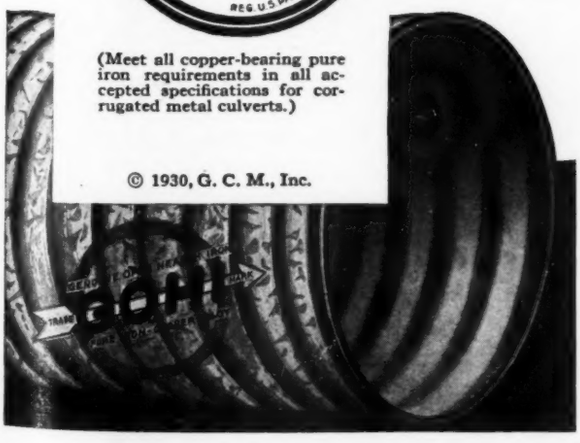
James H. Cox

Above—GOHI Corrugated Culvert installed in Putnam County, Tenn., in 1909. The almost perfect condition of this culvert, after twenty years in the ground, indicates a certainty of service of several times twenty years.

GENUINE OPEN HEARTH IRON
GOHI
TRADE MARK
PURE IRON - COPPER ALLOY
REG. U.S. PAT. OFF.

Corrugated Culverts

Made of Genuine Open Hearth Iron which is guaranteed 99.90% pure iron-copper alloy. Long service has proved the extreme resistance of this iron to corrosion, abrasion, freezing water, settling earth, and heavy traffic. GOHI Corrugated Culverts are easy to handle. Quickly installed. No repairs. No upkeep. Specify "GOHI" for lowest-cost-per-year drainage.



(Meet all copper-bearing pure iron requirements in all accepted specifications for corrugated metal culverts.)

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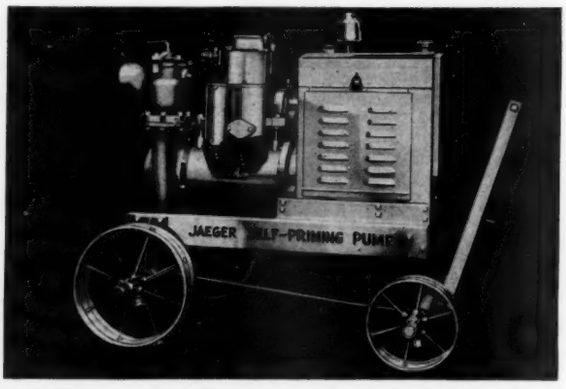

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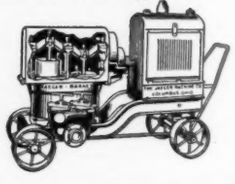
Self primer increases capacity; muddy water won't clog it. It's as sturdy and dependable as a pump can be. Write for 1930 catalog, prices.

SPEED BOY Centrifugal $167.50 complete.

Contractors and road pumps ...all sizes and types.



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in the meaning of the charter, an "aviation field" not being specifically enumerated in the provisions authorizing the voting and issuing of municipal bonds. This position also was held untenable. The Charter gives the city power "to acquire, maintain and operate public service property," etc., and to issue bonds for "public utilities" upon a majority vote of the electors.

The court said: "In a sense the Home Rule Charter is the constitution of the city. It is a frame of municipal government and is intended to be more permanent in its nature than an ordinary statute. In general features it is in a form to meet changing conditions as they arise. An equipped aviation field in or near the city is a means of making aerial service available to passengers. The service includes the transportation of mail and freight. The field is furnished for a public purpose for which taxes may be imposed in the exercise of governmental power. In this view of the question raised by the auditor, an equipped aviation field is both a 'public service property' and a 'public utility' within the meaning of the Home Rule Charter which authorizes municipal bonds upon a majority vote."

For these reasons a writ of mandamus compelling the registration and certification of the $100,000 municipal bonds voted for was allowed.

(To be continued)

Machine Finishing for Asphalt Pavement in California

(Continued from page 38)

ing under and lifting the mixture at each forward stroke, and on the backward stroke assisting slightly perhaps the forward movement of the machine.

Both the pendulum and sliding motions are induced by means of an eccentric connected to a counter shaft and operating crank arms which swing the rake's teeth or cause the whole raking element to slide.

The second method has, I think, certain advantages over the first, especially for thin surfaces.

The teeth are set to rake at from 16 to 20 strokes per minute, and have a travel independent of the forward motion of the machine of from four to eight inches. It is not desirable that the rake speed should be too fast nor the stroke too short. The sliding type of rake may have a longer stroke and be slower than the pendulum type.

Essential features of the raking are the lifting of the coarser aggregate to the surface of the mixture and the formation of compression ridges. The coarse aggregate being lifted to the surface allows it to be reimbedded in the immediate wearing surface by rolling and thus forms a non-skid surface. The compression ridges between the furrows left by the rake teeth have a tendency to assist compression without distortion or travel in the mixture, since the ridges are flattened out sidewise by the roller instead of being driven ahead by it.

Paving Operations

The paving operations in the construction of base and surface are as follows:

If a leveling course is to be laid on old concrete, a paint coat of emulsified asphalt is first applied to the concrete base.

Paving mixture heated to approximately 280 degrees F is brought to the road in pneumatic tired trucks of 5 or 6-ton capacity.

The trucks are backed up to spreader boxes and are attached to them by means of a quick detachable chain hitch. The mixture is roughly spread about two

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Consider the exclusive method, in Owen Clamshell Buckets, of mounting the lower sheaves on the main counterweight—high up in the bucket construction—where they cannot work in, and rarely come in contact with material.

Owen sheaves are large in diameter, properly grooved . . . upper and lower sheaves always in rigid alignment. There is no tipping—no side bends—no reverse bends so destructive to cables.

Thus Owen sheave and cable protection increases operating efficiency, reduces cable replacement and saves you money.

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17 POINTS OF LEADERSHIP

1. One-piece steel crosshead.
2. No wear in upper or lower arm ends.
3. Heavy high carbon steel arms.
4. Adjustable undiminished closing power.
5. Long life to sheaves and cable.
6. Long arm bolt bearings sealed from grit.
7. Lever type steel arm brackets.
8. Closing cable is protected against excessive wear.
9. Heavy shock-resisting renewable lips.
10. Cable clips eliminated.
11. Sealed center shaft bearings.
12. Greater digging power with no dead weight.
13. Penetration and clean dumping.
14. Dropping shocks absorbed, eliminating breakage.
15. Rigid shell construction.
16. Heavy duty high carbon drop-forged steel teeth.
17. Lips or teeth points hit first.

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IMPROVED SLANT TYPE
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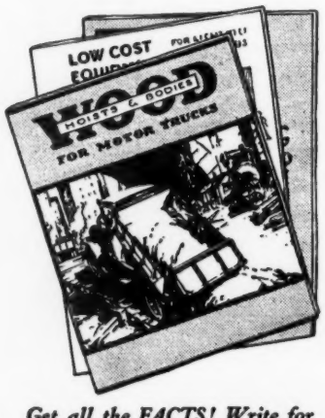
New power to lift heavy loads—new speed for fast dumping—new rugged unit construction; these features of the new slant type hoist built by Wood are evidence of new and greater value. The complete new line is our greatest achievement in hydraulic hoist construction.



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inches thicker than it will be left by the finishing machine and is at once spread to a uniform thickness using the screeds of the finishing machines only, as a usual thing. Some operators use the rakes also, as they think they assist compression. Rolling is begun as soon as the machines have spread a sufficient amount of material. Practically no hand work is required on the base mixture.

Base mixture is usually carried forward for such a distance as to allow a full day's run on surface, or for even a longer distance so that it will not be necessary to make so many shifts of the finishing machine. Machines are usually moved off the pavement at night to permit its use by through traffic.

Surface operations follow closely the methods used in constructing base, with a number of additional operations, however. It is first necessary to lay steel rails ¾″ to ⅞″ thick on top of the side forms, as hereinbefore described, to give the screeds the proper elevation above the side forms to allow for compression in rolling.

The screeds, which are cut at the center, are adjusted to the correct crown by means of hand wheels. The rake teeth are lowered into the mixture and in the sliding type are set at an angle of about 45 degrees.

During operation, it is desirable to carry a wave of mixture about half the height of the front screed in front of that screed and a smaller wave of mixture in front of the rear screed.

During the operation of the machine, the rakes are forming ridges and furrows longitudinal with the road and the rear screed is just knocking the top off the ridges, leaving coarse aggregate exposed for rolling. The machines are usually equipped for four-wheel-drive and will operate at a forward speed of up to 10 feet per minute.

Rolling

Rolling is done with ten-ton macadam rollers for the first compaction, followed by 6 to 8-ton tandem rollers for final smoothing.

Following the first rolling of the surface, our customary practice is to scatter asphalt-coated stone chips, passing ⅜″ and retained on ¼″, over the surface to fill any small voids which may be left in the surface and to provide additional assurance that the surface will be of uniform non-skid texture. Rolling is then continued until no more compaction is possible and the surface is as smooth as it can be made.

Smoothness

Surface smoothness is checked during construction by several different methods devised by ingenious resident engineers. The simplest method is, of course, to use a ten foot straight edge, but as this requires a good deal of stooping, other means have been devised.

One automatic device consists of a straight edge on three wheels so arranged that a rise or fall of the central wheel of more than ¼″ rings a bell; another has a similar bell arrangement but the straight edge consists of two sled runners; while another is a weighted sled which scores the high points as it is dragged after the roller.

The official record of rougness however, is made on a vialog or roughometer attached to an automobile operating at twenty miles per hour. This machine is kept constantly calibrated by checking its operation over two or three standard sections of pavement which have been run over many times and on which roughness has been accurately determined.

These men are laying a ROT-PROOF...SCAR-PROOF ...QUIET Bridge Flooring

THEY are doing the work quickly, with common, every-day tools. And—no waiting for the flooring to set or seal—as soon as the job is done, the bridge will be reopened to traffic.

Smoother, quieter, longer lasting —improving with traffic and time

Carey Elastite Asphalt Plank is a preformed, decay-proof combination of asphalt, mineral and fibre. Light, but dense and durable. It cannot splinter, it cannot corrugate. It absorbs vibration, resists mechanical wear. Used in bridge construction everywhere—the traffic surface that knits and heals in service.

The Keokuk-Hamilton Bridge, at Keokuk, Iowa, smooth-surfaced and bruise-proofed with more than fifty thousand square feet of Carey Elastite Asphalt Plank—in 1½" thickness, over a smooth sub-floor of wood.

Carey Elastite
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ASPHALT PLANK
... for Bridge Flooring

THE PHILIP CAREY COMPANY / *Lockland,* CINCINNATI, OHIO

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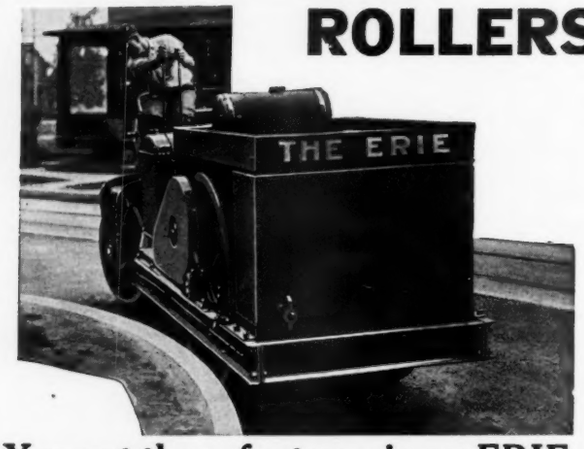
Pavements cost you less when rolled with ERIE ROLLERS



You get these features in an ERIE

Instant smooth reversing
Guaranteed high compression
Uniform hardness from curb to curb
Minimum of hand tamping
Better factory service
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Balanced weight, preventing sinking in or bridging
Clear view for the operator
Unequalled ease in steering

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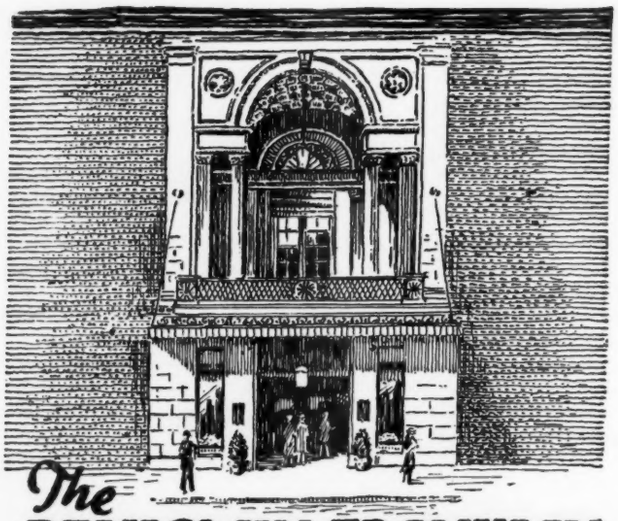
Roller Specialists for 40 years.



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Chestnut Street at Ninth
PHILADELPHIA

Combining traditional hospitality with attentive service, enjoyable environment and the most modern hotel appointments.

Twelve hundred rooms, each with bath
Rates commence at $4.00

HORACE LELAND WIGGINS, Managing Director

UNITED HOTELS

Please mention PUBLIC WORKS when writing to advertisers.

The following tabulation indicates the average smoothness we have obtained on some 200 miles of asphalt concrete pavement laid in the last five years:

Year	Miles Laid	Roughness Index	Remarks
1924	23.84	30.1	Hand finish
1925	24.11	33.2	" "
1926	49.34	24.1	" "
1927	35.35	25.2-14.6	Machine finish begun
1928	60.81	30.9-14.7	

We have been able to reduce the roughness to as low as eight units on some especially well finished jobs without sacrifice of the non-skid feature.

Output

The introduction of finishing machines has, as stated before, greatly increased the average tonnage output of paving plants, and has also decreased the cost per ton as shown in the following tabulation:

Year	Tonnage Max.	Per 8 hr. day average	Average cost per ton
1924	244	194	$7.27
1925	319	214	6.43
1926	388	333	5.13
1927	366	352	5.68
1928	574	404	4.89

Naturally, this increase in output has required larger plants and where a 1500 or 2000 pound batch box was the usual size in 1924, we are now using batch boxes up to 5000 pounds capacity, with the cost of the plant in proportion.

Cost of Laying Asphalt Concrete

The following comparisons of the cost of spreading asphalt concrete by hand and by machine were taken from two jobs completed within the last two years:

	By Hand		By Machine	
Output	300 tons per day		600 tons per day	
Labor:				
Foremen	1 at $8.00	$8.00	1 at $8.00	$8.00
Machine operators ...	..	..	1 at 8.00	8.00
Shovelers	8 at 4.50	36.00	4 at 4.50	18.00
Rakers	1 at 7.00	7.00	1 at 7.00	7.00
Rakers	2 at 6.00	12.00	1 at 6.00	6.00
Dumpman or Spreader box	1 at 4.50	4.50	2 at 4.50	9.00
Railmen	..	..	2 at 4.50	9.00
Screenings ...	2 at 4.50	9.00	2 at 4.50	9.00
Tampers	1 at 4.50	4.50	1 at 4.50	4.50
Totals	16	$81.00	15	$78.50
Spreading cost per ton ...		$ .27		.131
Machine rental per day..			$15.00	
Gas and oil per day			1.20	
			$16.20	
Cost of machine per ton				.027
Total cost of spreading by machine per ton				.158

Mosquito Control on Water Supply Reservoirs

(*Continued on page 39*)

shallows, flats, bights and similar areas, commonly in the heads of impoundings and of tributary streams.

Varying the water level from 6 to 8 inches each week during the active breeding season will strand many larvae. Others will be brought out into more open and active areas and thus be exposed to the elements and to natural enemies. There will probably be some shallow areas, however, where the fish cannot reach the larvae and here some type of larvicide may be necessary. According to information in hand, mineral oil is the most satisfactory larvicide for use in reservoirs. There is very little danger of its reaching the pipe lines, since it is usually applied at the upper end of the reservoir. However, oil will not give effective control where there is heavy vegetation, and we return to the original statement that a clean reservoir is the first essential to mosquito control.

POWER GRADERS
The "AUTOGRADER"
and "DREADNAUGHT."
RED SEAL
Continental Engines

HEAVY BITUMINOUS DISTRIBUTORS
(heater type) for Asphalts & Tars
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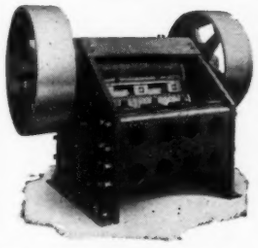
Good Roads

PATROL GRADERS
(drawn type)
ROAD ROLLERS
5, 7, 8, 10 & 12 *tons*
CHIP SPREADERS
Complete
ROCK CRUSHING OR
SAND & GRAVEL
PLANTS—*of any capacity.*



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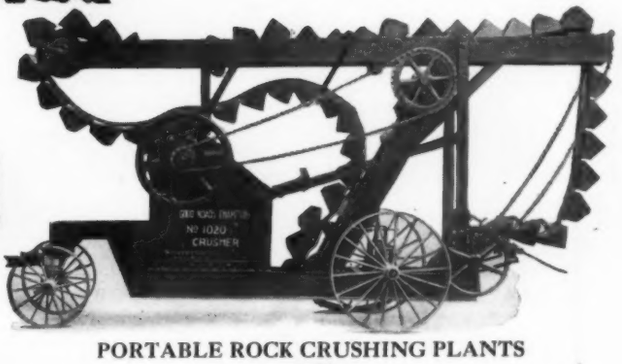
REDUCTION
CRUSHER
With S K F
Self-Aligning
Roller Bearings



PORTABLE ROCK CRUSHING PLANTS

Roads

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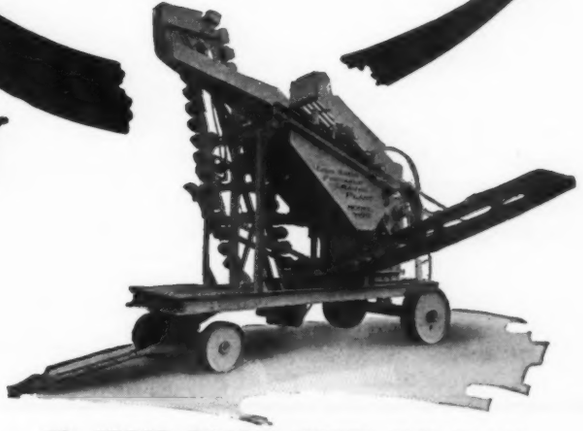

The "GOOD ROADS" MODEL Y-90 *Portable Gravel Plant—for Crushing, Screening and Loading*

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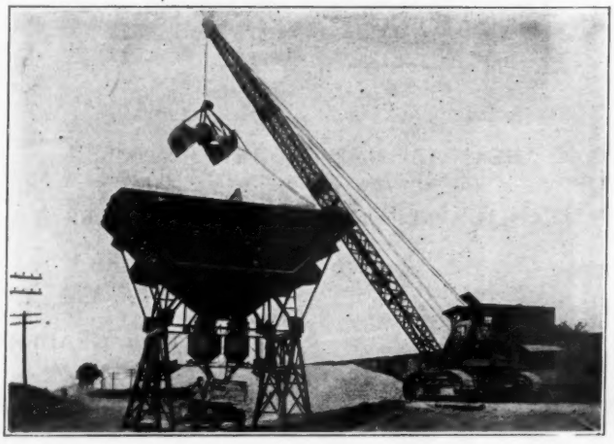
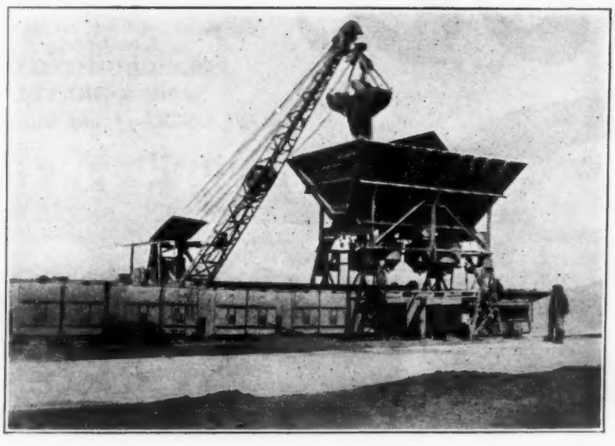
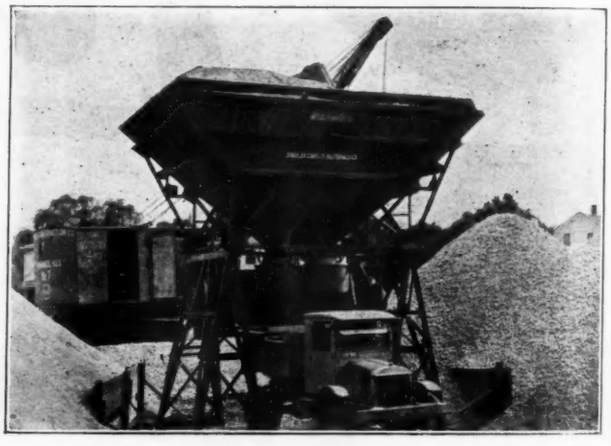
Portability—







plus—Capacity

Modern road construction methods demand the ultimate in equipment speed—each unit carefully chosen and timed to keep pace with every other unit—the complete equipment forming a compact plant capable of turning out consistent concrete, economically and fast.

Your batching plant is a vital factor. Speed in batching and accuracy in measurement are necessary requirements—but do not overlook portability and capacity.

Is your plant held up by lack of batching efficiency—have you sacrificed capacity for portability or the reverse? A Johnson Demountable Bin, consisting of eight units, shop fitted, shipped knocked down, and assembled in the field without bolting or special equipment, is available to take care of any capacity you may need, not only in 20 or 50 ton sizes, but up to and including 190 ton capacity.

The facilities of The C. S. Johnson Company, specializing exclusively in the design and construction of bins and batching units, are available for the solution of your material yard, central mixing plant or batching plant problems.

For true portability, plus full capacity, Johnson Bins offer you decided advantages—complete details will be sent gladly—without obligation.

THE C. S. JOHNSON COMPANY
CHAMPAIGN, ILLINOIS

Engineering Societies

June 2-6—AMERICAN WATER WORKS ASS'N. Annual convention at St. Louis, Mo. Beekman C. Little, Secy., 29 West 39th St., New York.

June 23-25—NATIONAL CONFERENCE ON CITY PLANNING. Annual conference at Denver, Colo. Secretary, Flavel Shurtleff, 130 East 22nd Street, New York.

July 9-11—AMERICAN SOCIETY OF CIVIL ENGINEERS. Annual convention at Cleveland, O. Secretary, George T. Seabury, 33 West 39th Street, New York.

September 24-27—INTERNATIONAL CITY MANAGERS' ASSOCIATION. Annual meeting at San Francisco, Calif. Executive Secretary, Clarence E. Ridley, 923 East 60th Street, Chicago, Ill.

October 6-11—SIXTH INTERNATIONAL ROAD CONGRESS at Washington, D. C. Secretary General, Thomas H. MacDonald, Washington, D. C.

October 7-10—AMERICAN ROAD BUILDERS' ASSOCIATION. International Exposition of Highway Equipment and Material at Washington, D. C. Secretary-Director, Charles M. Upham, National Press Building, Washington, D. C.

October 13-17—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual meeting at Richmond, Va. Secretary, C. W. S. Sammelman, 315 Commercial Building, St. Louis, Mo.

October 27-31—AMERICAN PUBLIC HEALTH ASSOCIATION. Annual meeting at Fort Worth, Texas. Executive Secretary, Homer N. Calver, 370 Seventh Avenue, New York.

New York State Sewage Works Association

The second regular annual meeting of the New York State Sewage Works Association was held in Albany, N. Y. on May 10, 1930. In the absence of the President, Kenneth Allen, the Vice-President, C. A. Holmquist, presided. Sixty-one members and guests were present.

The morning session was devoted to the regular business of the Association and to the presentation and discussion of two papers, one on "Operating Experience at the Syracuse Treatment Works," by W. P. Gyatt, chief operating engineer, and the other on "Essentials of Operation and Control of Small Sewage Treatment Plants" by C. C. Agar of the State Department of Health.

Wellington Donaldson New York City), W. A. Ryan (Rochester) and C. L. Walker (Ithaca) were elected members of the Executive Committee for a term of three years to succeed the retiring members, R. Suter, R. H. Gould and Kenneth Allen. Mr. Allen, however, will continue to serve on the Executive Committee for another year as an advisory member. The officers for the ensuing year are, C. A. Holmquist, President; Morris M. Cohn, Vice-President, and A. S. Bedell, Secretary-Treasurer.

The report of the Committee on the Short School for Sewage Works Operators was received with considerable interest as definite plans are being formulated for holding a one-week school at Schenectady during the coming autumn.

At the luncheon held in the DeWitt Clinton Hotel, C. A. Holmquist presented the greetings of Dr. Parran, the State Commissioner of Health, indicating his sincere interest in the aims and activities of the association. Following the luncheon, there was a lively round table discussion on the effect of industrial wastes on the operation of municipal sewage treatment plants, the propriety of allowing cellar drains to be connected to the sewer system and the specifications for house connections, led by R. S. Lanphear, R. C. Wheeler and Fred Fisch.

The meeting closed with an inspection trip to the sewage treatment plant of the city of Albany, and to the treatment works serving the Albany County Buildings where very complete treatment and odor control were well exemplified.

The next meeting of the association will be held on September 6, 1930, in Syracuse, Glenn D. Holmes serving as chairman of the local committee on arrangements.

Northern Michigan Road Builders' Association

The meeting of the Northern Michigan Road Builders' Association was held at Ironwood, May 8 and 9. Next year's meeting will be at Marquette.

Herbert F. Larson, Road Engineer for the Iron County Road Commission was re-elected president; C. F. Winkler, Road Engineer for the Gogebic County Road Commission was re-elected vice president and H. L. Wagner, Road Engineer of Baraga County was elected secretary to succeed Frank L. Betts, former Road Engineer of Menominee county, but now a member of the Bark River Culvert Company.

American Road Builders' Association

The annual business meeting of the American Road Builders' Association was held in Washington, D. C., May 15 and 16. Reports of old officers and committees were heard on the afternoon of the 15th, and at a dinner at the Willard in the evening, the new officers, headed by W. A. Van Duzer, president, were installed.

Membership in the association increased considerably during the year, according to the report of the outgoing president, Major F. A. Reimer. The year also was successful financially, the assets of the association increasing about $40,000, to nearly $200,000.

St. Louis was chosen as the place for the 1931 convention and road show.

Pennsylvania Water Works Operators

The annual conference of this association will be held at State College, Pa., June 24-25. Following the meeting, the Pennsylvania Sewage Works Association will meet at the same place June 26 and 27.

INDUSTRIAL LITERATURE

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A PUBLIC WORKS Service

The Crossroads of the Country are marked by The "EARLY" *Signs*

Write for descriptive folder and prices

TRAFFIC & STREET SIGN CO.
86 Foundry St., Newark, N. J.

200 APTS., 300 ROOMS

Milwaukee's finest popular-priced apartment hotel—near Lake—four blocks from business section. Each apartment has bath and shower. Beauty salon. Dining Room. Excellent garage and parking facilities.

Attractive weekly and monthly rates

THE PLAZA
551 Cass at E. State
On U. S. Highway 141
MILWAUKEE

COMBINATION

Steel and Wood

PIPE— *The Modern, Efficient, Economical Water Pipe.*

Used for Michigan Water Pipe is particularly adapted for municipal and industrial water supply and sewer lines.

Costs The cost of laying machine made steel and wood pipe is less than for any other pipe for water under pressure—no special labor or extra materials are used in making the joints—width of excavation is less—light weight permits laying without slow-moving block and fall.

Write today for full details

MICHIGAN PIPE CO.

Bay City, Mich.

Engineers' Club of St. Louis

At the annual meeting of the club held on May 8, officers were elected as follows: W. O. Pennell, chief engineer, Southwestern Bell Telephone Co., president; first vice-president, A. T. Hunter; second vice-president, A. H. Baum; third vice-president, G. A. Waters; treasurer, H. Shifrin; secretary, C. W. S. Sammelman.

Technical Publications

Ammonia-Chlorine Water Treatment.—The Ammonia-Chlorine or Chloramine process of water treatment, which has been found successful abroad and which has been recommended by such bodies as the British Ministry of Health, has now been installed in various communities in the United States for the purpose of improving the drinking water supply.

The claim is made that the Ammonia-Chlorine treatment is not only a more efficient bacteriacide than is chlorine alone but also rids the water treated of odors and tastes which are so often found in such municipal services. Ammonia-Chlorine treated waters also remain free from bacterial aftergrowths over long periods of time. Another important feature in favor of the process is its power to eliminate objectionable chlorinous and chlorophenol tastes and odors incident to the use of chlorine. It also makes for economy in the use of chlorine.

In addition, it is believed that the new process will be found valuable in other fields, such as the purification of water in swimming pools, and in several industrial processes subjected to the formation of slimes such as occur at some stage of the operations in paper mills, tanneries, animal products plants, textile industries, wall board manufacture and other activities.

In the Ammonia-Chlorine or Chloramine process the water is first treated with ammonia. This is done by introducing the ammonia into the water by means of an ammoniator, an apparatus that is essentially the same as the apparatus employed for feeding chlorine into water supplies except its parts are made of materials impervious to the action of Ammonia. It appears that pre-ammoniation is desirable to obtain the best results and some time is allowed to elapse between the introduction of ammonia into the water and chlorination. The ammonia and chlorine react to form chloramines in the water.

Aside from drinking water supplies it is believed that swimming pools will constitute an important field for its use and the British Ministry of Health recently pointed out its advantages for this purpose. Swimming pools as a rule are heavily charged with chlorine; in many cases, to the point of discomfort to the bathers. The new treatment, it is claimed, would eliminate the strong and disagreeable tastes and odors.

Among the municipalities now employing the Ammonia-Chlorine process for the treatment of waters are Greenville, Tenn., Springfield, Ill., Lancaster, Pa., Media, Pa., Phoenixville, Pa., Philadelphia, Pa., Burlington, N. J., Bay City, Mich., Cleveland, Ohio., Beaver Falls, Pa., East Liverpool, Ohio, Allentown, Pa., Hyattsville, Maryland, Defiance, Ohio, Greenville, Pa., and Warren, Ohio.

Further information may be found in the booklet "The Ammonia-Chlorine Treatment of Water," which is published by the National Ammonia Company, Inc., New York, Philadelphia, St. Louis, and Seattle, Wash.

Personals

Victor Arnold, for many years district manager of the Pittsburgh Equitable Meter Company's New York office, has purchased the property and assets of the Phoenix Meter Company, located at Prince's Bay, Staten Island, N. Y., and has reorganized the company. Mr. Arnold's company will hereafter be known as the Phoenix Meter Corporation, and he will continue to manufacture the well-known Phoenix meter. Ernest Gamon, who has been connected with the company since its organization is now consulting engineer. Both Messrs. Arnold and Gamon have had very wide experience in both manufacturing and selling of meters, and have many acquaintances in the industry. Sales and executive offices of the company have been opened at 50 Church St., New York, N. Y.

S. F. Crecelius has been appointed city engineer of El Paso, Texas.

E. A. Doyle, Consulting Engineer of The Linde Air Products Company has been elected president of the American Welding Society.

C. K. Dykstra has been appointed city manager of Cincinnati, Ohio, succeeding Col. C. O. Sherrill, who resigned to enter business.

Gardner S. Williams, consulting engineer, Ann Arbor, Michigan, has been appointed a member of the Committee on Flood Control of the American Society of Civil Engineers.

Clyde C. Whipple, Assistant Professor of Electrical Engineering at the Polytechnic Institute of Brooklyn has been granted leave of absence for one year by the Corporation of the Institute to serve as visiting professor in electrical engineering at the Green School of Engineering of Princeton University.

Public Officials:

Cut costs this way..

Here's a sound plan that has proved practical for thousands of public officials and other successful business men: To cut your hauling costs, put a Dodge Truck to work.

Dodge Trucks are confirmed money-savers for these reasons: They have the power you need for hill, hole or soft ground. Provide the speed that enables you to make more trips and save more time. Insure the dependability you want for year-after-year adherence to schedules. Attract patronage by their fine appearance. Please drivers by their roadability, comfort and handling ease. Are so designed and built that economy and long life are definitely assured.

See your Dodge Brothers dealer. Inspect Dodge Trucks. Compare them. Drive one. Choose from 124 standard types, ranging in capacity from ½-ton to 3-tons. Buy one complete with body. Rest assured that it will cut your costs.

DODGE TRUCKS

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Engineering and Construction Equipment

New Machinery, Apparatus, Materials and Methods and Recent Installations.

The Shunk Success Heavy Duty Road Maintainer

A road maintainer has recently been placed on the market by the Shunk Manufacturing Company, Bucyrus, Ohio. The Shunk Manufacturing Company recently took over the Success Road Machine Co. of Jacksonville, Ill., the company which formerly manufactured and sold the Success Maintainer. The machine has been improved by the Shunk engineering staff and was shown for the first time at the Southwest Road Show held in Wichita, Kansas, February, 1930.

The maintainer, a multiple blade machine, is built for heavy duty maintenance work. Its frame, built of 6 in. channel steel, is thoroughly braced and riveted. There is stated to be no blade jump or chatter, nor any side draft. The entire weight of the machine can be placed upon the twin dual blades. The three point draft draw puts the pull low down near the center of the blades, where it is most effective. Being a light draft machine a 15-30 H.P. tractor affords ample power for operation; a safety pin feature is provided so that greater power may be used without injury to the machine.

Each set of dual-blades are separately controlled by three large hand wheels, easily operated, to raise or lower the heel or toe or to draw them into the machine into a neutral position. The rear blade is also raised or lowered with its own handwheel. Two additional adjustments offer varied positions for this blade. The large and roomy platform gives the operator free access to all of these adjustments.

The twin-dual or multiple blade feature is a patented and exclusive feature of the maintainer. All five blades are double edged, extra wide, high carbon steel, reversible and interchangeable to all positions on the machine. They are concaved, ground and polished.

Klinck Test and Puddle Plug

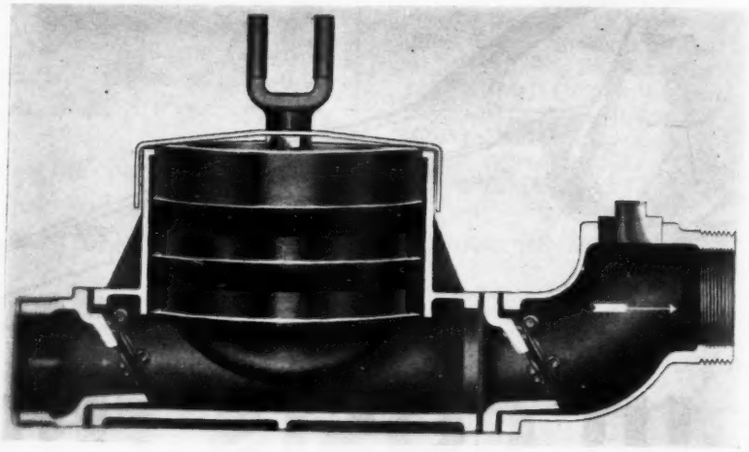
Harry W. Klinck, of Logansport, Indiana, formerly superintendent of the Logansport Water Works has procured a patent on a Test and Puddle Plug for use in backfilling the trench where new water mains are laid.

It is customary when laying water mains, to test the joints under pressure before placing the dirt back in the trench. Then after the joints are found to be tight the trench is filled in. If the soil is not tamped in layers as the trench is filled a mound several feet high is usually left over the pipe. Tamping, however, is very expensive and slows up the work considerably.

The Test and Puddle Plug serves two purposes. It is inserted in the end of the pipe and tightened in place. This plugs the pipe and allows the water pressure to be applied for testing the joints. Dirt is then dumped into the trench a few feet behind the end of the pipe to form a dam across the trench. A short piece of two-inch pipe or hose is coupled into the Test and Puddle Plug and water from the main is allowed to fill the trench behind the earthen dam and the soil is dumped into the trench. No tamping is necessary as the soil packs as it is dumped in trench. While the trench is being filled the Test and Puddle Plug may be removed to allow the laying of additional pipe. By this method the trench may be backfilled as the work progresses and thus eliminate the danger caused from open ditches.

In a comparative test on laying three hundred feet of six-inch pipe the savings amounted to more than the cost of the Test and Puddle Plug. The cost of laying a mile of pipe is reduced by $400 to $600 by this method, depending on the depth of the pipe and the kind of soil.

The Klinck Test and Puddle Plug is being manufactured and marketed by the H. W. Clark Company, Mattoon, Illinois. At the present time it is made in sizes for 6″, 8″ and 10″ pipe. Other sizes will be placed on the market soon.



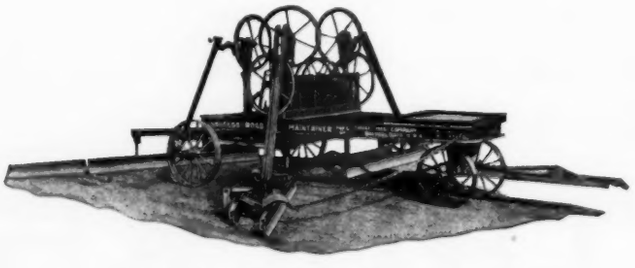
Section of New Novo Pump.

A New Type of Pump by Novo

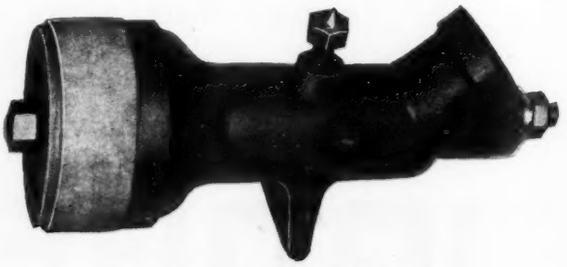
The Novo Engine Company, Lansing, Michigan, have designed, tested and put on the market a pump that is entirely new in principle, design and performance.

This pump is known as the Roller Ring Plunger Pump. One of the main features of this pump is that it does away with the old service "bug-a-boo" of changing diaphragms, packing the pistons, etc., for it has no diaphragms, no packing or oil seal.

An absolutely liquid tight water seal is maintained by two rubber rings on the plunger that roll with the action of piston as they are pressed against the cylinder wall. The rolling action of these rings prevents friction and hence



Shunk Heavy Duty Maintainer.



Klinck Test and Puddle Plug.

Cambria Crescent,
Norfolk, Va. Photographed Mar. 1930.

Kyrock Laid 1906

24 Years under Traffic

Maintenance - Negligible

A Good Street To-Day

Cambria Crescent, Norfolk, Va.
A Kyrock surface, now in its 24th year of continuous service. It is without ruts, cracks or waves. Its resiliency is unimpaired. Test measurements do not disclose any abrasive wear and its surface retains its initial coefficient of friction. Laboratory tests of samples cut from this surface in February, 1930, show no chemical change in the bitumen and no loss in bitumen content. Kyrock does not lose its *life*.

Many miles of streets and highways of various types laid 10, 15 years ago have taken a toll for maintenance equal to their original construction cost — many have disintegrated and been replaced. This Kyrock street has given uninterrupted service for 24 years at but little more than its original construction cost. It is good for many years to come. On the basis of cost per mile per year, Kyrock is the cheapest material available.

Investigate Kyrock. KENTUCKY ROCK ASPHALT CO., *Incorporated,* Marion E. Taylor Bldg., Louisville, Ky.

Kyrock

The Uniform Pavement

KENTUCKY ROCK Kyrock ASPHALT

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lack of wear permitting the use of one set of rings for a season's work.

Due to the rapidity of the strokes of the plunger, which operates at 120 strokes per minute, water is forced through the pump at a very high velocity, permitting it to carry along with it a great deal of foreign material held in suspension. This is also facilitated by the fact that it is a straight line flow from the suction inlet to the discharge. Also the rapidity of the strokes create a more constant and uniform flow of water, for there is no lull between strokes as is the case of a slower acting pump.

The pump is compact and light, weighing only 960 pounds. It has a capacity of 3,500 to 5,000 gallons per hour and develops a 100-foot head. For high speed hauling it may be mounted on a coil spring rubber tire trailer. The standard mounting is on a four-wheel truck.

New Universal "512" Shovel

A one-piece gear case which encloses all of the operating mechanism is a feature of the New "Unit 512" designed by the Universal Power Shovel Company, division of the Unit Corporation of America, Milwaukee, Wisconsin. This one-piece gear case encloses all operating mechanism so that it operates in a continuous bath of oil, a design which has proved its advantage in both automobile and truck operation.

Every control is within easy reach of the operator's seat. For instance, a special, free-working split crowd drum, within reach of the driver's seat, enables the slack in crowd lines to be taken up in a few seconds. The operator only uses the boom hoist lever and rotates the free-working special split crowd drum. In this operation, lifting the boom relieves normal crowd tension.

A positive independent forward and reverse crowd assures complete control of dipper stick. The most adhesive materials can be quickly shaken from the bucket. The design makes the weight of the boom act as a shock absorber to relieve gears and cable of excessive strain.

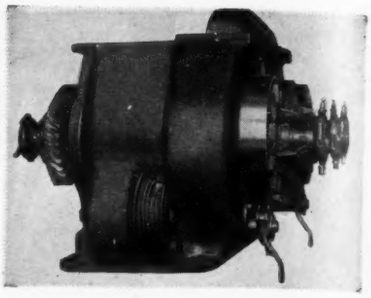
This model is powered by a "Waukesha" VK Motor with governor. Bore, 4¼"; stroke, 5"; R.P.M., 1400, developing 48 H.P. Equipment includes air cleaner, American Bosch Magneto and pusher type fan which ventilates the cab. Muffler and exhaust which conducts gas high into the air increases operating comfort and makes entire machine quiet running. This power is ample for extreme digging conditions; to move the turn table through six revolutions per minute, and to pull the shovel through five dips in a minute. Traction speed is ¾ to 1¼ m.p.h.

Universal "512" Shovel.

The 512 Unit is presented as a machine to move material at low yardage cost. The production capacity of any excavator depends on the speed and ease of operation to even a greater extent than the volume of earth moved with each cycle. It is on this basis that the Universal Power Shovel Company has designed and developed the 512 Unit shovel—a machine which represents a comparatively small initial investment and an exceptionally low production cost, while giving the owner ample capacity with unusual flexibility in service. The machine is easily and quickly converted to clamshell, dragline, trenchoe, crane or backfiller, and these change-overs may be made very readily.

Mohawk Hotstuf Asphalt Heaters

The Mohawk Asphalt Heater Co., Schenectady, N. Y., manufacture the Hotstuf asphalt heater, which, it is claimed, has eliminated the problem of burning out. These heaters have distinct hot and cold chambers. The elevated melting chamber is separated from the lower storage chamber by a solid removable partition plate with an opening at the bottom, separating the cold material.



The "512" Gears Run In Oil.

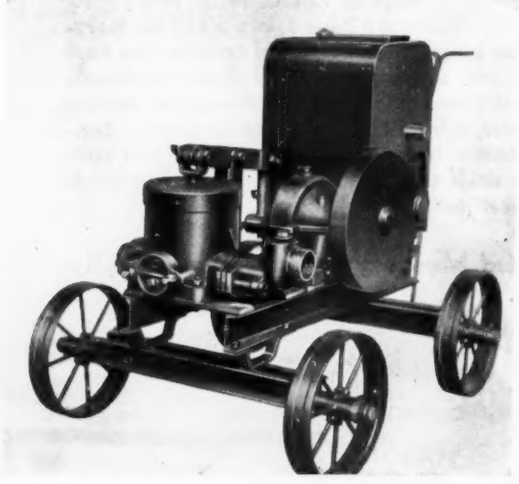
The most important feature is the patented elevated melting chamber which, it is stated, produces 30 per cent greater melting capacity with 30 per cent less fuel. This construction eliminates coking, by the natural flow of the hot material carrying the sediment to the storage chamber and thence through the draw-off valve.

Connersville Rotary Meters for Sewage Gas

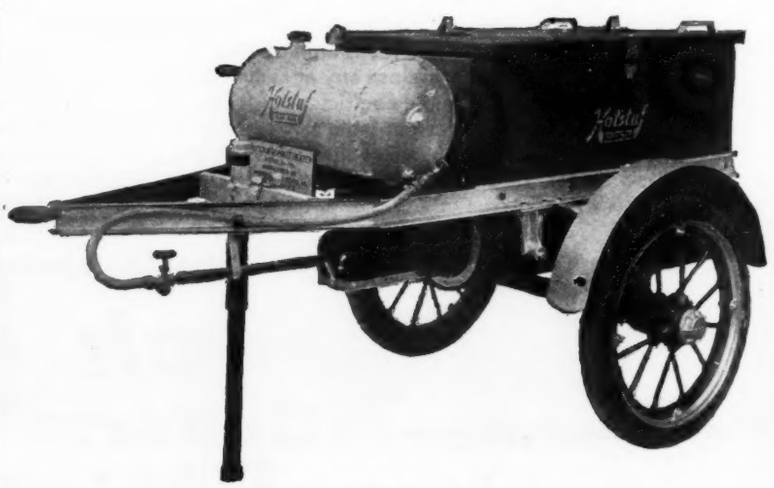
The Connersville Blower Co., Connersville, Ind., manufacture rotary displacement meters which are being used to give dependably accurate measurement of the gas that is formed and drawn off of sewage sludge digestors.

These meters have been installed in plants at Springfield, Ohio, Dallas, Texas, and San Antonio, Texas, and orders have been received for meters to be used in three of the larger sewage disposal plants that are being erected in the central west.

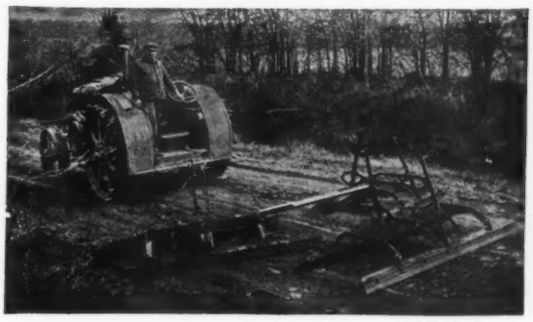
The features in these meters which appeal to the users, are accuracy of measurement, the dependability of operation, because of sturdy construction, and simple design, which has eliminated any delicate parts that might require



Standard Mounting, Novo Pump.



Mohawk Hotstuf Asphalt Heater.



Left: The Connersville Rotary Meter Measures Sewage Gas Accurately. Right: The 2-Lever Drag Maintainer in Operation.

frequent repairs or adjustment; also the ease of installation of the meters and their ability to operate at very low differential pressures.

The illustration shows a meter with a standard totalizing register which reads direct to the nearest 100 cu. ft. On several installations, these meters have been furnished with a special recording instrument, and while this instrument is primarily used in the gas industry as a demand recorder, it also serves as a flow recorder, showing the amount of gas passing through the meter showing different intervals of time.

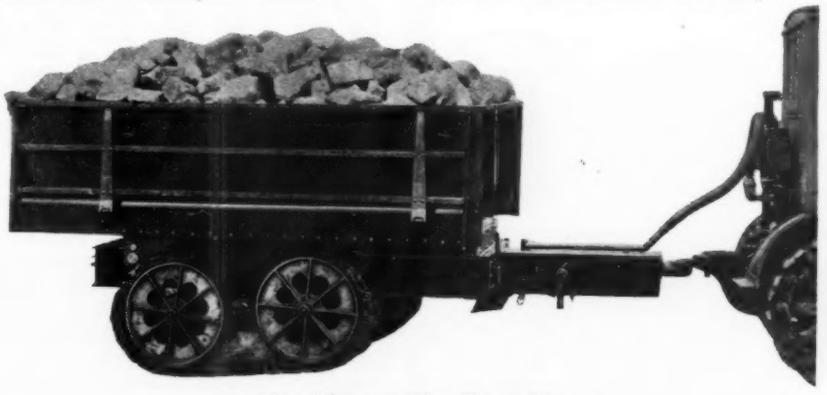
These meters may be used on any service where the gas flow will be 500 cu. ft. per hour or greater.

The rating given is the normal capacity, but any of these meters will maintain their accuracy of measurement through a variation in capacity, ranging from approximately 10% to 200% of the normal rating. This is due to the fact that the unit of measurement is the displacement per revolution of the impeller, which is a fixed, unvarying and nonadjustable volume determined by accurately machined cast iron surfaces. The speed of rotation of these impellers will vary, however, as the flow of gas varies, for the impellers cannot rotate until they have been filled with gas.

La Plant-Choate Three-Way Dump Wagon

La Plant-Choate Mfg. Co., Inc., Cedar Rapids, Ia., manufactures a 3-way crawler dump wagon which has a capacity of 7 to 8 yards. This wagon is designed to meet any need of the contractor, for side or rear dumping equipment, in that it dumps either to the rear, to the right or to the left. It is hydraulically operated, with down-folding doors which open and close automatically as the body is raised and lowered. The entire dumping operation is controlled by the tractor operator from his seat on the tractor.

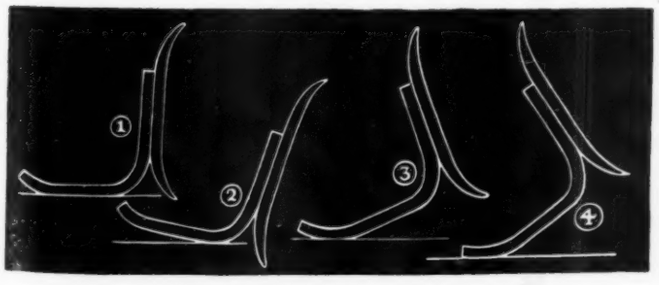
The body on the La Plant-Choate 3-way dump wagon is built by the Differential Steel Car Company, of Findlay, Ohio. Their experience and success in building bodies have been combined in the construction of this new body which is mounted on La Plant-Choate chassis and "Roadlayer" tracks.



La Plant-Choate 3-Way Dump Wagon.

The body, frame, and tracks are built entirely of steel, made to withstand the roughest treatment and hardest usage.

Because of the absolute and quick escapement, this wagon is particularly adaptable to building roads or dams in mountainous territory where the fills have to be either side or end. The discharge opening is so large that the widest shelf rocks, handled by the shovels today, can be easily dumped. It is also ideal for use in rock quarries or places where materials are to be dumped on conveyor belts.



How the 2-Lever Drag Maintainer Works.

The General Planetainer

The General Wheelbarrow Co., Cleveland, O., manufactures the General Planetainer, a new type of 2-lever drag maintainer. This machine combines the leveling principle of the drag with the cutting action of the road patrol or maintainer. The front blade is a curved grader blade similar to that used on a regular maintainer. To the back of the blade is attached a curved steel planing shoe that irons out the road. The blade and shoe may be set to plane, cut, or iron. The machine is suited to do any kind of maintenance work under any kind of road condition.

The Planetainer is said not to jump about on the road, leaving uneven places. The steel shoe holds the blade to the road. If the road is hard, or there is much material to be moved, the Planetainer may be weighted down to make it more effective, or the operator may ride on the wide platform. The channel steel cross bars provide a sure footing for him.

The blades are adjustable to eight positions by levers conveniently located for the operator. Each blade is seven feet long, with the rear blade offsetting the forward by a foot, which gives the machine an eight-foot cutting width.

For wide roads three Planetainer units may be joined together. The two forward units are held apart by an adjustable angle steel strut bar. The length of this strut may be changed to fit varying widths. The third unit is fastened by short chains directly behind the gap between the forward units. When joined together in this manner the 3-way Planetainer will work an 18-foot strip. For narrower roads the single or 2-way Planetainer may be used. The

A Traffic-Line Marker for YOU!

Few cities or towns now have hand-painted traffic lines. Nearly all use a traffic-line marker of some kind. But before you buy a line-marking machine, be sure that you have checked over the features of the Traf-O-Mark.

A marker should make a clear, visible line . . . be simple to operate . . . easy to clean. You will have this in the Traf-O-Mark. Write for complete information.

The Traf-O-Mark can be equipped with rollers to mark 4-, 5- or 6-inch lines. Specify the size you want.

LITTLEFORD
Traffic Line Marker
TRAF-LB-MARK
LITTLEFORD BROS. 452 E. PEARL ST. CINCINNATI, O.

HEADLEY EMULSIFIED ASPHALTS

GRADES

No. 1
SUMMER MATERIAL
Road and Highway Construction and Maintenance
Railroad Crossings and Platforms

VIAFALT
WINTER MATERIAL
Road and Highway Construction and Maintenance
Railroad Crossings and Platforms

No. 10
Soft and Tacky Finish
ALL YEAR MATERIAL
Mastic Flooring and Concrete Patchwork
Unexposed Waterproofing and Damp-proofing

No. 11
Hard Non-Tacky Finish
ALL YEAR MATERIAL
Exposed Protective Coatings of all sorts at all times
Specifications on Request
OTHER GRADES FOR SPECIAL PURPOSES

PRACTICAL
DURABLE ECONOMICAL
SOLVE YOUR PROBLEMS
with
EMULSIFIED ASPHALTS
No Heating No Solvents
IDEAL
COLD-METHOD APPLICATIONS
PAVING USES
COLD PATCHING RESURFACING
WATERPROOFING USES
ROOFING DAMP-PROOFING
PROTECTIVE COATINGS FOR
METAL AND MASONRY STRUCTURES

Literature on request.

Headley Emulsified Products Co.
Philadelphia, Pa.

For latest catalogs—consult the *classified* INDUSTRIAL LITERATURE section, beginning on page 119

single unit can be drawn by a team. The 2 and 3-way Planetainers require a tractor.

The Planetainer can be bought much more cheaply than the average maintainer, and the cost of maintenance is exceedingly low. The blades are reversible; when one edge is worn out, the blade is turned over and bolted on again, thus getting double wear.

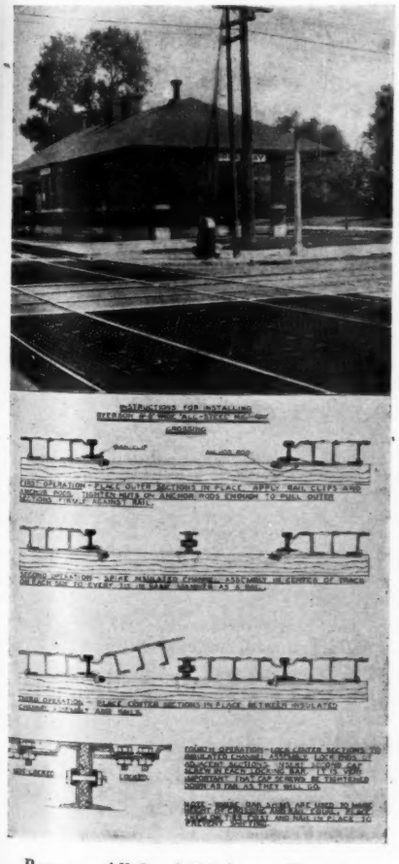
The single unit Planetainer comes completely equipped with two independently operated 7-foot blades, planing shoe and hitch chains. The 2 and 3-way Planetainers come complete with necessary strut bar and connecting chains for joining together. The single unit complete with shoe weighs 340 pounds.

Ryerson Develops New All-Steel Highway Crossing

A highway crossing made entirely of steel, that will withstand the heaviest traffic loads indefinitely, has been placed on the market by Joseph T. Ryerson & Son, Inc., Chicago, Ill.

Simplicity in construction combined with a sturdiness found only in thick steel plates have given this new crossing wide prestige among railroad maintenance men.

It is made of one-quarter inch steel plates, firmly riveted to steel channels and zees. An unique feature of the all-steel crossing is the ease with which it is installed. Four men will put in an eight-foot section in less than a half hour.



Ryerson All-Steel Highway Crossing.

Where installation requires the two rails to be electrically insulated from each other, two rolled steel channels are bolted together with a one-inch creosoted wood strip in between. The bolts are provided with fibre bushings and washers. These bolted channels are then spiked midway between the rails in place of the center I-Beam. The ends of the crossing are bent downward to the ground to prevent dangling chains or air hose from catching in the crossing. Ample circulation of air insures against rotting of the ties.

The all-steel crossing includes several safety features which help to prevent accidents. The plates have a tread which prevents skidding. They are on an exact level with the tracks and highway, making the entire crossing a smooth riding surface. The motorist encounters no bumps, therefore it is not necessary for him to cross at slow speed, thus eliminating the danger of stalling his car on the tracks. During the winter months, while an abundance of snow might be found on the highway, the crossing itself is usually clear, as snow does not tend to cling to the cold steel, and is easily blown off.

Mathews Modernized Hydrant

Important improvements have been made by R. D. Wood & Co. of Philadelphia, Pa., in their Mathews hydrant. While the basic principles of the hydrant remain unchanged, certain features have been re-designed to meet the modern demand for a hydrant that is stronger, tougher, more resistant to breakage from shock, and more easily replaced, if broken by traffic accidents without digging or breaking the pavement.

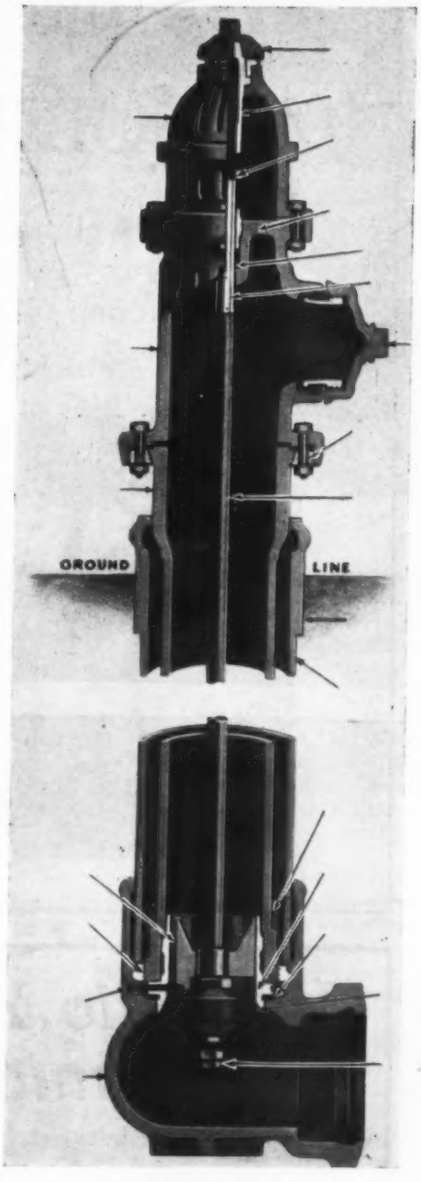
The outstanding feature of the Mathews always has been the removability of the barrel, without digging, for repair or replacement. The modernized Mathews improves even this quality. Four lugs have been cast on the outside of the barrel at the base. A tube wrench slips down over these lugs, to unscrew the barrel.

At the top of the hydrant a malleable iron shield-operating nut prevents rain and sleet from seeping down and freezing around the operating nut. The operating stem stuffing box plate is cast integral with the nozzle section; thus there is no pressure strain exerted on the head bolts when the hydrant is open and a separate part is eliminated.

One of the outstanding new features of the Mathews modernized hydrant is the revolving head, which makes it easy to face the nozzles in any direction, without disturbing the barrel, simply by loosening the bolts in the swivel clamping ring.

The overall strength of the new hydrant assures greater resistance to shock. The barrel and protection case sections are cast by the Sand-Spun method which produces concentric castings of greater tensile strength, elasticity, and toughness.

The cost of replacing broken hydrants has been further reduced by the adoption of a beaded protection case extension which slips down over the regular protection case. Usually when a hydrant is broken by being struck, it is only the barrel and this extension piece which suffer. The main protection case will rarely be broken, as this beaded extension will receive the major strain of the shock.



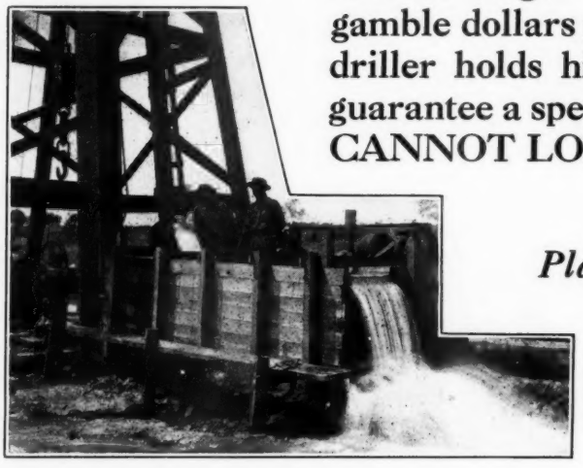
New Mathews Hydrant.

The drain valve and the upper section of the main valve are combined in one casting, and the drain valve slides against a bronze cylinder which prevents wear on the liberal sized drain valve leather. The main valve does not revolve, but moves to and away from its bronze seat with the minimum of friction and wear. Being cone shaped, it opens and closes gradually, thus preventing water hammer, and reducing the possibility of gravel or other foreign matter lodging on the seat.

Complete details may be obtained by addressing R. D. Wood & Company, 400 Chestnut Street, Philadelphia, Pa.

SCIENCE versus LUCK

Layne has eliminated the element of chance in the water producing business by applying scientific methods to construction of well systems.



It is no longer necessary for municipalities to gamble dollars away in a game where the well driller holds high hand. LAYNE contracts guarantee a specified quantity of water. YOU CANNOT LOSE.

Play safe! Write for bulletins

Layne & Bowler, Inc.
MEMPHIS TENNESSEE

What do YOU demand of a Municipal Garbage Incinerator?

Highlands, N. J.
25 tons per day

A new 24 page booklet containing data and information on municipal garbage disposal by incineration will be sent to you upon request. No obligations. Simply ask for Booklet No. 77.

The garbage incinerator that your city or town will build and operate must give satisfactory performance, operate and build at low cost, and present a pleasing appearance. Your engineers will make stringent requirements as to these three factors in order to give your community the best and most satisfactory means of municipal garbage disposal.

Many towns and cities that demanded an incinerator having these outstanding characteristics are now operating Pittsburgh-Des Moines plants and feel that they have carried out their program to perfection.

The Pittsburgh-Des Moines incinerator operates at and above 1400° F which insures the complete combustion of all refuse and the elimination of all objectionable odors. The plant is guaranteed to operate in a satisfactory manner.

Standard materials and standard designs in the construction of the plant keep initial and maintenance costs at a low figure. The plant is simple in design. It can be easily operated by unskilled labor. Little commercial fuel is required and by reason of its satisfactory and odorless operation the plant can be centrally located which results in a short average hauling distance and consequently low collection costs.

The possibilities in architectural treatment are unlimited. Many Pittsburgh-Des Moines plants now in operation are, in their pleasing appearance, a real pride to the communities owning and operating them.

Thirty active years in constructing public utilities enables us to give the best of service in building a Pittsburgh-Des Moines incinerator for your town or city.

Pittsburgh-Des Moines Steel Company

79 Neville Island, Pittsburgh, Pa.

683 Hudson Terminal Bldg. **981 Tuttle Street**
New York City **Des Moines, Ia.**
Chicago **Atlanta** **Dallas** **San Francisco** **Seattle**

For latest catalogs—consult the *classified* INDUSTRIAL LITERATURE section, beginning on page 119

New Johnson Bantam Weight Batcher

The Johnson bantam weigh batcher, for wheelbarrow batching of accurately weighed aggregates, is designed for building, culvert, small bridge, and curb and gutter work where the job does not justify the setting up of a complete bin and batching unit. It is built by C. S. Johnson Co., Champaign, Ill.

Weighing but 280 pounds it can be loaded and unloaded easily from trucks, and with the two large diameter wheels can be moved around on the job by one man. The shoveling height is forty-two inches, a height tested to prevent easy tiring. The capacity is four cubic feet or four hundred pounds, a full wheelbarrow load.

The discharge is a simple sliding gate with nothing to get out of order—high enough for any standard wheelbarrow. The hopper is round and free from any obstructions that might allow the materials to build up. Only the material directly in it affects the weight.

The feature of the bantam batcher is the weighing unit. Scale parts are entirely of bronze, eliminating rust and standing up under long service. The beam balance indicator, warning the operator of approaching balance, balance, and overload, can be read from either side. All that is necessary is to set the beam for the desired weight, run the wheelbarrow under the discharge, and shovel into the hopper until the beam balance indicator shows a balance. It is an extremely simple unit, without springs, eliminating the usual necessary wait for the beam to balance.

The bantam batcher is a unit entirely separate from the mixer and is consequently not affected by mixer vibration, it permits the mixer to move along with the job, without the necessity of constant moving of the stockpile.

Johnson Bantam Weight Batcher in Use.

New Ingersoll-Rand Portable Air Hoist

Ingersoll-Rand Company, 11 Broadway, New York City, has introduced a new-sized "Utility" Portable Air Hoist of 2000 lbs. capacity. "Utility" Hoists, in capacities up to 1500 pounds, have been used by miners and contractors for the past three years. The addition of the 2000-pound size makes this type of hoist available for additional classes of work.

Ingersoll-Rand Utility Hoist.

The uses for "Utility" Hoists are varied. In mines they are used for hoisting timbers, tools, pipe, and drill steel into stopes and raises; hauling and spotting cars, hoisting muck, etc. Many of the same uses for the hoist are found in quarries and smelters as well.

In construction work they are used on derricks for hoisting buckets in caisson work, pulling cars, skidding timbers, handling pipe, and operating clamshell or orange-peel buckets. They can also be used for hoisting material, erecting tanks and smokestacks, pulling sheet piling, and driving piles.

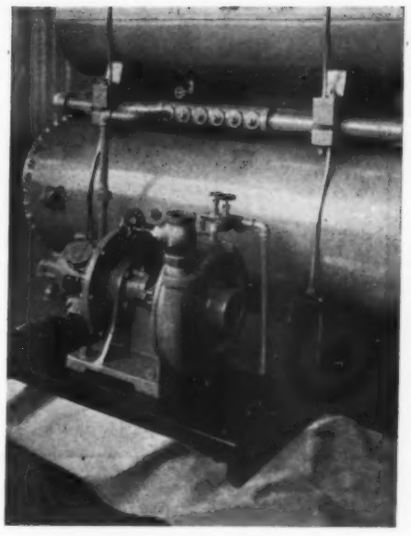
The fact that the hoists are of comparatively light weight permits them to be readily moved about wherever there is work to be done. The hoists can be bolted to a timber or mounted on a post or steel column in any convenient location.

The "Utility" employs a radial, four-cylinder, counterbalanced, reciprocating-piston-type air motor, which is reversible. All wearing parts and cylinders are easily renewable, and the cylinders are also interchangeable.

The gears are completely enclosed in a housing, which excludes all dust and permits the gears to operate in a bath of semi-fluid grease.

Ball and roller bearings are used at all points where they will add to the efficiency and life of the hoist.

The motor is completely enclosed in a dust- and dust-proof case.

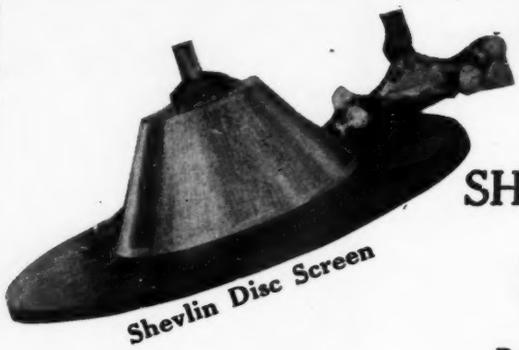


Air-Motor-Driven Pump.

Air-Motor-Driven Pump by Ingersoll-Rand

Ingersoll-Rand Co., 11 Broadway, New York City, has announced an air-motor-driven pump, known as the "ACV." The pump is a Cameron single-stage, single-suction, open-impeller, volute type and is driven by a four-cylinder air motor.

It can be mounted on a shelf at the rear of a portable air compressor. In this position, the connecting pipe between the air receiver and the motor will not interfere with the operation of the hose line supplying air to the drills. Ample space is left on the shelf for a



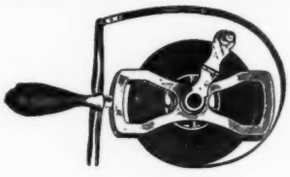
Shevlin Disc Screen

Disc Fine Screens for Sewage

SHEVLIN ENGINEERING CO., Inc.

229 Fulton St., New York City

You are invited to inspect plants built by us:
26th Ward Brooklyn—Two 26 ft. Diam. and two 14 ft. Diam. Disc Screens
Rye Beach, N. Y.—Two 12 ft. Diam. Disc Screens
Irondequoit Plant, Rochester, N. Y.—Two 12 ft. Dia. Disc Screens



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Stocked by Hardware and Engineering Supply Houses

THE LUFKIN RULE CO.
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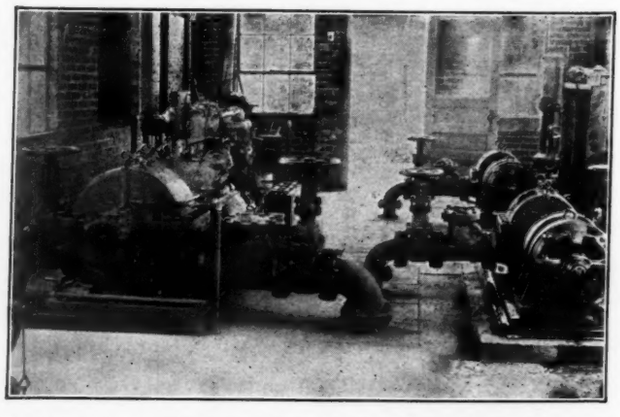
There Is Not Such a Great Difference in the Price

But There Is a Whale of a Difference in What You Get

A Sterling High duty internal combustion engine for emergency

Sterling
THE ENGINE OF REFINEMENT

is worth investigating.



Davidson, N. C., emergency unit consists of a Goulds pump driven by a Model FC-4 cylinder 100 HP., Sterling engine.

Write for a booklet—7 minutes reading—and learn why Sterling counter-weights its crankshaft, furnishes an oil cooler and filter, a water jacketed exhaust manifold.

STERLING ENGINE COMPANY, Dept. C-5, Buffalo, N.Y., U. S. A.

For latest catalogs—consult the *classified* INDUSTRIAL LITERATURE section, beginning on page 119

tool box, which does not hinder the operation of the pump.

The unit is positive in action, and will prove useful for dewatering trenches and excavations that have become filled overnight. It will also keep the workings free from water caused by surface drainage or seepage while the men are at work.

The capacity of the pump, with 60 pounds air pressure at 1000 r.p.m., is 130 g.p.m. against a 29-foot head. With 80 pounds air pressure at 1200 r.p.m., the capacity is 125 g.p.m. against a 43-foot head. These figures are based on a 20-foot suction lift.

Industrial Notes

The name of the Reading Meter Repair Co., Reading, Pa., has been changed to Hydraulic Equipment Co.

Chain Belt Company of Milwaukee has moved its New York Office into new and larger quarters. For a number of years their New York Office was located at 50 Church Street. The new quarters are in the new Chrysler Building, 405 Lexington Ave., New York City.

The directors of The Jeffrey Manufacturing Company at the annual meeting elected Robert W. Gillispie president and general manager of the company. He was formerly vice-president and general manager. At the same time the board elected Robert H. Jeffrey, former president of the company to the position of chairman of the board.

The Heltzel Steel Form & Iron Company announces the appointment of the following representatives: Raleigh Tractor & Equipment Co., Raleigh, North Carolina; Lombard Iron Works & Supply Co., Augusta, Georgia; Gorman L. Burnett, Inc., P. O. Box 291, Lynchburg, Va.; Dravo Equipment Co., 300 Penn Avenue, Pittsburgh, Pa.; Dravo Equipment Co., 4800 Prospect Ave., Cleveland, Ohio.

The Cleveland Tractor Co., Cleveland, O., recently delivered to Cuyahoga County, Ohio, for use on road work, a fleet of tractors consisting of three Model "40" and two Model "80-60" tractors.

The town of Oswego, New York, has ordered an FWD six-wheeler. The town of Marquette, Michigan, ordered a 2½-ton FWD, and Alger County ordered two 3-ton FWD's from the Upper Peninsula Tractor Company. The Township of North Bethlehem, Pennsylvania, ordered a 2-ton truck. And the town of Rochingham, Bellow Falls, Vermont, a 2-tonner, all FWD's.

The State Highway Department of Idaho recently placed an order with the Idaho Equipment Company for 2 FWD two-ton trucks and two six-wheelers. The six-wheelers are to be fitted to operate rotary snow plows.

Trade Publications

Large Cast Iron Lines.—The U. S. Cast Iron Pipe and Foundry Co., Burlington, N. J., has published a beautifully illustrated book on large cast iron lines.

Used Equipment.—Zelnicker of St. Louis has just published a 24-page bulletin covering a very wide line of used and new equipment of all sorts for construction, railroad, mine and quarry, boat, dam and other purposes.

Centrifugal Pump Priming.—Barrett, Haentjens & Co., Hazelton, Pa., have published a valuable bulletin in centrifugal pump priming covering the following: Priming; with submerged pumps, with foot valves, ejector priming; by hand, vacuum pump priming; power primers; arrangement of intake piping.

Turbines for Water Works.—A 12-page bulletin published by the General Electric Co., which contains a great deal of valuable information regarding construction, operation and efficiency.

Pump Guide—This booklet put out by the Chicago Pump Co., Chicago, Ill., shows what pumps are used for the different services and gives engineering data on each pump. There is also a section devoted to "useful information," which gives tables useful in figuring pumps. In the "Pump Guide" only the points of major importance are presented.

HOME

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By W. A. HARDENBERGH

Associate Editor of Public Works

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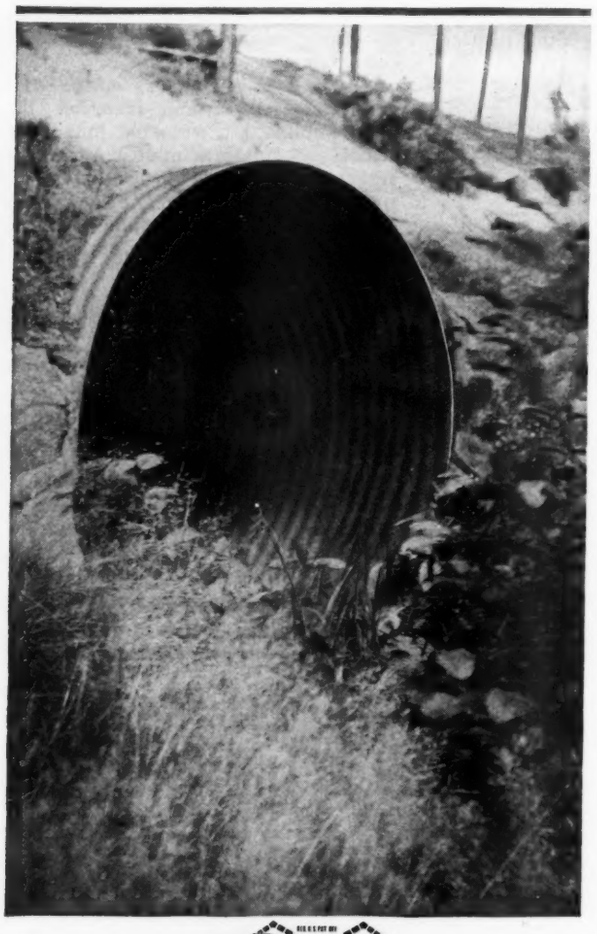

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Albany's New Water Supply

(*Continued from page 41*)

vation 618, while the top of the dam is at elevation 625. Sluice gates are provided in the gate house for taking water at four elevations, the lowest of which drains the reservoir entirely.

All the trenching and pipe laying was done by labor-saving machinery and methods. The line was

Alcove Dam, Showing Riprap in Left Foreground, and Gate House in Middle Distance.

dug principally by Link-Belt trench hoes, which, as they moved forward, also laid the pipe in place. A length of pipe weighed over 9,000 pounds. An average cover of four feet was called for, so that the usual depth of the trench was about 8 feet. The width varied with the material, ranging from 7 to 12 feet. The pipe follows the general contour of the country.

In rock, which was encountered over quite a considerable distance, the procedure of trenching was varied somewhat. A light shovel was sent ahead to strip off the surface soil, which was piled to one side, to be used later in bedding the pipe. Another small shovel then followed and stripped off such loose, decomposed and soft rock as was possible and piled it to the other side. The trench was then blasted, and one of the large trench-hoes went over the line, taking out the broken rock and bringing the trench to grade.

As soon as a section of the trench had been dug, the trench-hoe reached round, picked up a section of the pipe and placed it in the trench in position. In this way, pipe-laying kept up with trenching. On the entire line, Leadite was used for joints.

The pipe was only partially covered at first. Backfilling is now being completed, using an Austin gasoline crawler-mounted shovel with a 1-yard bucket, and a ¾-yard crawler mounted "General" excavator.

The filter plant, which is now under construction,

Laying Pipe With Link Belt Trench Hoe.

will be of the rapid sand type, and will have a capacity of 30 million gallons per day. The elevation of the filters will be about 400 feet above that of the city, which is some 12 miles distant.

The engineers in charge of the work are Whitman, Requardt and Smith of Baltimore, and Robert Horton. The general contractor is Winston & Co., Kingston, N. Y., while Pepper Bros. of Syracuse and Albany are doing the pipe installation work. The pipe was furnished by the U. S. Pipe and Foundry Co.

A "General" Excavator Backfilling Along the Pipe Trench.

Link Belt Hoe Trenching and Laying Pipe in Rock.

An Austin "Bear-Cat" Backfilling in Rough Country.

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And don't forget to visit the Steamboat Cabin Coffee Shop at the Mark Twain—it is the talk of the town—different in surroundings and food also.

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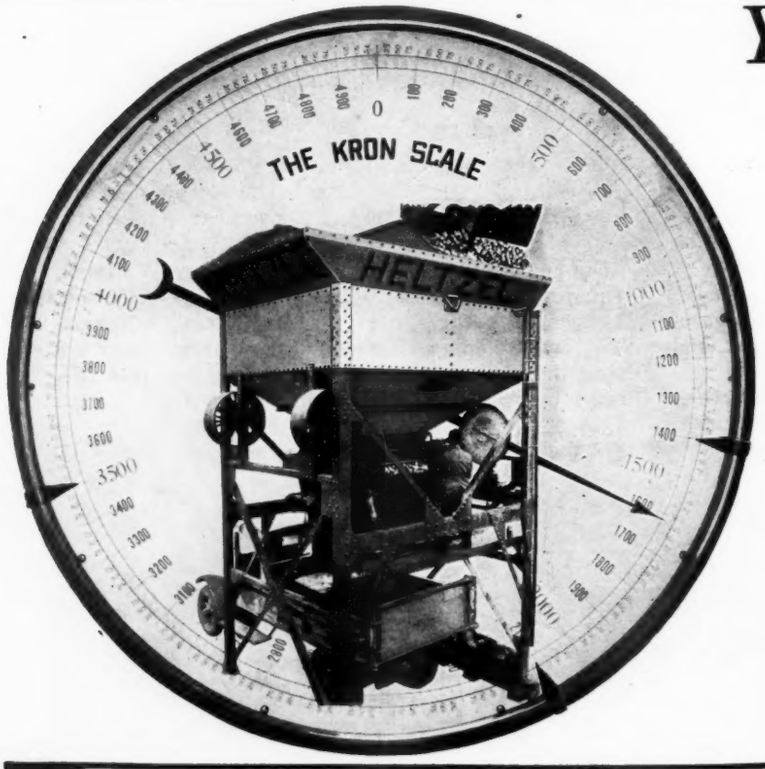

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Preventing Flood Damage to Roads

(*Continued from page 44*)

stream side as the water flows over the road, and will prevent wash from commencing.

Large stone rip-rap is effective in many cases; as is small stone, either plain or grouted. However, there is a neater method, just as effective and often more economical, that will sometimes commend itself. Clean sand and cement thoroughly mixed in the proportion of one to five is placed in old sacks, saturated with water and placed neatly on the slopes. The sacks should be filled full and tied, then saturated with water and placed end to end firmly against the slopes, breaking joints; then "walked" down until the ends come thoroughly in contact, with square surfaces.

This method of rip-rapping is very effective also in the protection of subsidiary bulkheads in timber bridge construction; although in this case the sacks are only about half-filled and the ends not tied, and they are placed butts up-stream and walked down until about four inches thick for approximately two-thirds their length and one inch for the one-third space toward the mouth of the sack; and on top of the thin end is laid the next sack, which is compacted firmly up against the first; and so on across the entire top of the bulkhead.

This method gives a more impermeable covering than stone, one that will not wash away, nor will it crack up like a thin monolithic slab. Usually good river sand can be found near a bridge, which makes this a readily available and economical method to use. It has been placed for less than half the cost of stone; but this will, of course, depend on the cost of the stone.

Where sufficient notice of advancing high water is had, the above method can be used for immediate protection, and will serve as permanent relief after subsidence of the water. In this case it may be placed dry and walked down, the rising stream providing the water to complete the setting up of the mixture.

A good grass sod on the down-stream side of an embankment will afford good protection against washouts and crumbling of slopes. Cases are known where a good mat of grass withstood a moderate current from three to four days. Also, on water-ravaged embankments I have seen large triangular shapes of earth jutting up, still held in place by the tenacious roots of grass, while places unprotected had been swept away.

In sand-bagging along a highway when it is reasonably sure the water can be held so as to keep traffic moving, also to prevent scour on down-stream slope, the bags should be placed along the upper side of the road, lapping over the edge of the pavement sufficiently so that, in event the water does come over the bags, it will fall onto the hard surface. Back-filling with earth on up-stream side of bags will assist materially if time is available and material convenient.

Where the road is a traffic-bound one, it is better not to attempt holding the water off it unless very sure it can be done; for if the water should flow over the levee or break through, the whole fill is liable to be lost. Sand-bagging on the down-stream side is sometimes effective in allowing the head to equalize, or nearly so. Then when a break-through or overflow does occur its effect will be minimized.

Where there is little or no head in slow rises, little damage will be done by overflow itself, and the only consideration is stoppage of traffic. In this case, conditions peculiar to the existing problems will govern the best procedure. However, continued inundation will cause sloughing which may weaken the fill to such an extent that a break-through will occur.

Building of earth dams along a highway to prevent overflow is a dangerous practice, especially in uncertain stages. When thoroughly saturated, they are liable to give away and cause more damage from the increased head than would have occurred if the water had been unobstructed. Earth dams require a great amount of material and are expensive to erect, and it is necessary that they be watched closely and frequent additions of material made.

Sometimes jetties will assist materially in protecting a fill where there is a swift current. They should never be constructed of untreated timber, as the temporary protection it provides is liable to induce a false and dangerous sense of security. Jetties are of especial benefit back of bridge ends, as they will divert the current away from the place most susceptible to attack.

County Highway Maintenance by Contract

(*Continued from page 82*)

determine what speed the equipment can make and at the same time do what work is necessary.

The contract price per hour for the operation of the units includes cutting weeds and brush from right of way. We allow the extra man on each unit to do the necessary hand cutting, etc., when the truck is spring blading.

Due to the experience that we have gained, we expect to make some changes in the specifications. Relative to the speed of the units, while daily operations on the same road can of course vary, the annual average speed can be determined partially by the experience we had last year. It will be seen by the table that our average speed for the 6½ months for trailer blade work was 4.27 miles per hour, and for the spring blade was 5.3 miles per hour. (We did not include in the specifications any amount per hour because of the lack of information relative to the economical speed.) The speed of a unit should be directly related to the cost of repairs and amount of work done. The contractor says he had practically no repairs due to the speed of the units for the past year, so that apparently the speed can be increased during 1930, and we have set the trailer blade speed at 5½ miles per hour ,and the spring blade speed at 8 miles per hour. We are preparing a graph month by month, showing on one axis the miles per hour and on the other the cost of repairs to equipment, including cutting edges, etc. The amount of work done is that which is necessary to fill the wave ruts and indulations.

There has been some attempt to pay according to pressure upon the cutting edges, but I hardly think that is practical, although I think that some check can be made in this way on work done.

Jacob Herzog is chairman of the county board, G. S. Burnham is the vice-chairman, and the other members are D. A. McKee, Iver Uglum and O. W. Cummings.

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